Transport Canada Transports Canada

TP 1624

Marine Casualty Investigations

Enquêtes sur les accidents maritimes

Investigation Report to the Minister pursuant to sections 542 or 545 of the Canada Shipping Act

Rapport d'investigation au Ministre conformément aux articles 542 ou 545 de la Loi sur la marine marchande du Canada

Canada

Ce rapport est aussi disponible en français

REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE LOSS OF THE CANADIAN FISHING VESSEL "BONNIE LOU II" AND HER CREW OF FIVE, IN A POSITION EAST AND SOUTH OF SABLE ISLAND, ATLANTIC OCEAN ON OR ABOUT MARCH 8, 1988

REPORT No. 514

These sections of the Investigation Report prepared pursuant to Section 542, or of the Preliminary Inquiry Report prepared pursuant to Section 545, of the Canada Shipping Act, are released for accident prevention purposes only and are confined to cause-related circumstances.

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- E R R A T A -

These typographical errors in the previously published report should be corrected as follows:

Marine Accident Report

Circumstances attending the loss of the Canadian fishing vessel "BONNIE LOU II" and her crew of five, in a position East of South of Sable Island, Atlantic Ocean on or about March 8, 1988.

REPORT NO. 514

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Annex V

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REPORT OF INVESTIGATION INTO THE CIRCUMSTANCES ATTENDING THE LOSS OF THE CANADIAN FISHING VESSEL "BONNIE LOU II" AND HER CREW OF FIVE, IN A POSITION EAST AND SOUTH OF SABLE ISLAND, ATLANTIC OCEAN, ON OR ABOUT MARCH 8, 1988

Particulars of Vessel

Name	"BONNIE LOU II"
Official Number	320640
Port of Registry	Canso, NS
Gross Tonnage	82.34
Net Tonnage	39.00
Length	19.14 m
Breadth	5.97 m
Depth	2.23 m
Built	1964, Cheticamp, NS
Propulsion	One GM 8V-71 diesel engine driving a single, fixed-pitch propeller and capable of attaining 169 kW. The engine could be controlled from the wheel-house and a dog-house.
Crew	Five
Classification	Home Trade II, East Coast of Canada
Owner	Independent Fisheries Halifax, Nova Scotia
Operator	Lorne Marshall Gray Armdale, Nova Scotia

Navigating Equipment

The following equipment is documented as having been on board the "BONNIE LOU II":

Radar (1)	Raytheon R 40
Radar (2)	Sitex T 100
Echo Sounder (1)	Sitex Koden

Echo Sounder (2)	Paper
Loran C (1)	Internav LC 300
Loran C (2)	TL 828
VHF Radiotelephone (1)	Horizon Maxi
VHF Radiotelephone (2)	Ray Jefferson S 100
SSB Radiotelephone	Icom M 700
Autopilot	Robertson AP 100

Vessel Description

The "BONNIE LOU II" was an all-wooden fishing vessel of closed construction with accommodation forward of and below the wheel-house and the engine-compartment beneath the slaughter-house with access from the wheel-house.

Abaft the slaughter-house was a fish-hold and at the after extremity of the maindeck was a lazaret. A complete description of the vessel is contained in Analysis 3.

The "BONNIE LOU II" underwent a quadrennial survey in January/February 1984 and was issued an SIC 29, February 2, 1984. This certificate expired February 1, 1988 but the vessel was granted a two month certificate extension, February 8, 1988 at Sambro, Nova Scotia.

The vessel was classed Home Trade II East Coast of Canada which permitted operation to 120 miles offshore and not more than 200 miles between ports of refuge.

Note: All times stated in this report are expressed in Atlantic Standard Time (UTC minus four hours.)

A glossary of terms and abbreviations may be found following the Findings of this report.

Background

The fishing vessel "BONNIE LOU II" departed from Sambro, March 6, 1988 for a fishing venture in the Sable Island area.

After setting their longlines for fishing cod, the "BONNIE LOU II" communicated on three occasions with the fishing vessel "HALF RASPY" during the period between 0700 and 2100, March 7, 1988.

At 1800, March 8, 1988, the "BONNIE LOU II" indicated to the "HALF RASPY" that she had taken a sea and sustained damage to the upperworks in addition to there being water in the engine compartment.

A further call to the "HALF RASPY" forty-five minutes later assured the crew of that vessel that all was well and that the pumps were coping with the water in the engine compartment.

The "HALF RASPY" advised the "BONNIE LOU II" that she would maintain a listening watch on 2,738 kHz. The position of the "BONNIE LOU II" at that time, as determined by Loran C readings, relayed by the "BONNIE LOU II", was 44°05'24"N, 58°29'36"W.

Nothing further was ever heard from the "BONNIE LOU II" and although some debris and a liferaft were recovered during a four-day air and sea search, the five crew members were not found and all are presumed to have drowned.

The vessel was reported to have a value of $250,000.

Missing

Dennis Aden Gilkie
Age 26
Sambro, Nova Scotia

James Michael Gray
Age 26
Sambro, Nova Scotia

Brian Theodore Gray
Age 19
Sambro, Nova Scotia

Blair Arthur Gray
Age 30
Sambro Head, Nova Scotia

Lorne Marshall Gray
Age 29
Sambro, Nova Scotia

Narrative

The Canadian fishing vessel "BONNIE LOU II", equipped for longlining, departed from Sambro, Nova Scotia, during the early hours of Sunday morning, March 6, 1988, bound for the eastern bar of Sable Island and the gullies of Banquereau Bank.

On board was a crew of five and the vessel carried 5 tonnes of ice, 9,000 litres of diesel oil (6.4 tonnes), 1,400 litres of fresh water (1.4 tonnes) and approximately 2 tonnes of fishing gear.

At 0700, March 7, the skipper of the "BONNIE LOU II"

conversed with the skipper of the Canadian fishing vessel, "HALF RASPY" on VHF radiotelephone, channel 6, stating that his vessel was on the eastern side of 'Seventy-Seven Peak Gully' (44°15'N, 59°04'W) and that they were fishing for cod. The conversation included how much fishing gear was set and where. At this time, the "HALF RASPY" was on the western side of the same gully, some 12 miles from the "BONNIE LOU II".

Two further communications were made that day between the same two vessels, at 1200 and at 2100. At the time of the latter conversation, the "BONNIE LOU II" was reportedly heading for 'South-West Cove' (44°12.5'N, 58°29'W). From past experience, the skipper of the "HALF RASPY" anticipated that the "BONNIE LOU II" would idle down all night and start to set her gear during the early hours of March 8.

An existing gale warning for Banquereau Bank, issued at 0000 March 7, was upgraded to a storm warning at 1515, March 7. A previous gale warning had been issued at 0530, March 5 and ended at 1130, March 6.

The weather conditions throughout March 7 and the first hours of March 8 appear to have been favourable with light variable winds from the south-west quadrant ranging from between 5 and 14 knots.

At 0630, March 8, the crew of the "HALF RASPY" set one half of their gear and shortly after 0700, called the "BONNIE LOU II" on VHF radiotelephone, channel 6, but there was no response and it was assumed that the two vessels were beyond reception range. However, intermittent calls were made throughout the morning simply to exchange progress reports but these calls went unanswered.

By 0800, the wind had veered to the north-west and suddenly increased, resulting in the skipper of the "HALF RASPY" being forced to steadily retrieve his gear. At 1200, with the wind now estimated to be 35 knots, half of his fishing gear was inboard but by 1600, the wind speed had increased to 50 knots and the seas had built up to a height estimated to be 8 m. Due to these conditions, the last string of hooks was left set.

At approximately 1800, the wind was reported to be north-north-west at 60 knots and gusting with the seas in excess of 10 m.

As darkness approached, (sunset was at 1750), the "HALF RASPY" was called by the "BONNIE LOU II" on SSB radiotelephone, 2,738 kHz, and the skipper of the "BONNIE LOU II" advised that he had trouble in that his vessel had taken a

big sea and broken the starboard slaughter-house door. He also advised that his vessel was taking water in the engine-compartment.

It was suggested by the skipper of the "HALF RASPY" that efforts be made to correct the problems and to advise him when all was well.

At approximately 1845, the skipper of the "BONNIE LOU II" called back to confirm that the door was repaired and that the pumps were coping adequately in the engine-compartment. The skipper of the "HALF RASPY" advised the "BONNIE LOU II" that a continuous listening watch was being maintained on SSB radiotelephone, 2,738 kHz and, that if any further problems arose aboard the "BONNIE LOU II", the skipper should call the "HALF RASPY". The position of the "BONNIE LOU II" was ascertained at that time, by the "HALF RASPY" from Loran C co-ordinates to be 44°05'24"N, 58°29'36"W which was approximately 33 miles from the "HALF RASPY".

Sable Island, some 60 miles to the westward, recorded NNW winds during the night of March 8, 1988 with sustained winds of 40/43 knots, with maximum gusts of 60 knots being recorded at 2200, March 8.

Nothing was heard throughout the night from the "BONNIE LOU II" and, at 0500, March 9, the skipper of the "HALF RASPY" started a calling procedure to the "BONNIE LOU II" which was maintained throughout the ensuing 24 hours.

The Canadian fishing vessels "WET AND WILD" and "JOHNNY AND SISTERS II" also tried to communicate with the "BONNIE LOU II" by both VHF and SSB radiotelephones, but without success. These vessels were estimated to be 50 and 25 miles distant, respectively, from the "BONNIE LOU II".

By 1200, March 9, the wind had subsided to north-west 45 knots and at 1600, the "HALF RASPY" resumed fishing yet still trying to contact the "BONNIE LOU II". It was assumed that perhaps the radiotelephone aboard the "BONNIE LOU II" was inoperable but when nothing had been heard by 0500, March 10, the skipper of the "HALF RASPY" checked with the "JOHNNY AND SISTERS", "WET & WILD" and the Canadian fishing vessel, "ATLANTIC HORIZON". None of these vessels had either seen or heard the "BONNIE LOU II".

At 0555, the skipper of the "HALF RASPY" called CGRS, Sydney (VOC) on SSB radiotelephone 2,182 kHz to express his concern over the "BONNIE LOU II". The information was relayed to RCC who initiated a major air and sea search for the "BONNIE LOU II".

Between 0925, March 10 and 2215, March 13, eight aircraft and four ships were involved in a search which covered approximately 12,166 square nautical miles and during which time, there were ten sightings of debris.

Due to adverse weather conditions, much of the sighted material could not be retrieved by the surface vessels. The damaged liferaft from the "BONNIE LOU II" was among those items recovered. Its canopy was missing and a lower flotation chamber seam had separated. (See Analysis 11 and Annex III)

The crew members have not been found and all are presumed to have drowned.

Analysis

1. Environmental Conditions

a. Weather pattern

The loss of the "BONNIE LOU II" occurred in the Banquereau Bank weather forecast area. A gale warning was issued for that area at 0530, March 5, and discontinued at 1130, March 6. A further gale warning was issued at 0000 March 7.

On the morning of Monday, March 7, 1988 a large high pressure area was situated south-east of Newfoundland and was moving rapidly eastward. Marine areas south of Nova Scotia were experiencing moderate southerly winds.

By Monday evening, a trough of low pressure had moved over the Maritimes, stretching from a low pressure centre in the northern Gulf of St. Lawrence to a low at 37°N, 61°W.

At 1515, March 7, the existing gale warning issued at 0000 March 7 for the Banquereau Bank area was upgraded to a storm warning with winds forecast to be north-westerly to 50 knots. The storm warning remained in effect until the forecast issued at 0045, March 10 and winds were predicted to attain a velocity of up to 60 knots.

Weather observations recorded at Sable Island indicated a marked increase in wind velocity between 0600 and 0700, March 8, and the increase continued throughout the day with sustained velocities up to 43 knots and gusts to 60 knots

(See Annex VI). One vessel which was 250 miles south-east of Sable Island, reported sustained winds of 70 knots at 2000, March 8. By early morning, March 8, the trough of low pressure lay along the meridian of 58°W and a new low pressure centre had formed at 44°N, 58°W, 22 miles from the last known position (LKP) of the "BONNIE LOU II".

There was little indication available as to local conditions due to a minimum of weather-observing vessels in the area. Sable Island supplied frequent updates and with reports of a rapidly falling barometer, the indication was that the low pressure centre was quickly deepening as it tracked north-westward.

During the afternoon of March 8, the low pressure centre had deepened a remarkable 1.8 kPa in 6 hours, such a rate of fall being apparently a very rare occurrence. At 1400, a vessel in position 45°24'N, 57°30'W, reported north-north-westerly winds with a sustained velocity of 46 knots.

By the evening of March 8, the low pressure centre had moved to a position south-east of the Avalon Peninsula although the north-westerly winds maintained a high velocity, and throughout the ensuing 24 hours, the area to the south of Banquereau Bank was subjected to gale to storm force conditions.

b. Wave analysis

No significant wave action was either forecast or reported from early morning March 7, through early morning March 8, the average confirmed wave height being from 2 to 3 metres. A weather observation from a vessel in position 42°30'N, 55°W indicated waves of 3.6 m during the late morning of March 8.

As the day progressed and the wind increased in strength, reports indicated wave heights in excess of 6 m in areas south-east of Cape Breton.

At 1800, March 8, the skipper of the "HALF RASPY" reported winds in excess of 60 knots and a sea height of 10 metres.

The rapid and unpredictable deepening of the low pressure centre during a 6 hour period, March 8, would probably account for the sudden increase of wind velocity and sea height as reported by the skipper of the "HALF RASPY".

It could be conjectured that the "BONNIE LOU II" was subjected to the effects of the wind and sea when she was perhaps in a vulnerable situation (See Analysis 6).

The marine forecasts issued by Environment Canada during the period March 7 to March 10, were accurate in their content and prognoses despite the unpredictable fall of the barometric pressure on March 8. These forecasts were available to fishing vessels in the Sable Island area and could be received on VHF radiotelephone channel 83B, 161.775 MHz via a satellite transmitting station on Sable Island and also on SSB radiotelephone, 2,738 kHz. The storm warning was reportedly received aboard the "HALF RASPY", "JOHNNY AND SISTERS II" and "WET & WILD".

2. Search and Rescue Operation

No regular reporting system was adopted by the owner ashore, and the operators of his vessels. The practice had been for a company representative to make irregular calls to a vessel during a fishing venture for progress reports. No calls were made to the "BONNIE LOU II" during the 60 or so hours that the vessel had been at sea.

At 0555, March 10, the skipper of the "HALF RASPY" called CGRS VCO by radiotelephone to express his concern over the loss of communication with the "BONNIE LOU II".

The content of this message was relayed to RCC, Halifax at 0606 giving the last known position of the "BONNIE LOU II". Immediate efforts were then made to locate the owner and obtain a complete description of the vessel.

This information was eventually received from the owner's representative in Halifax as the owner was out of the country.

At the request of RCC Halifax, made at 0746, attempts were made by CCGVs "SIR WILLIAM ALEXANDER" and "WILLIAM" to contact the "BONNIE LOU II" by radiotelephone on both VHF and SSB frequencies. No response was heard.

At 0925, a C.F. Buffalo aircraft from Summerside PEI was tasked to search for the "BONNIE LOU II", followed by further taskings during the day of other aircraft and of surface vessels. At 0924, RCC issued an Urgency message which was to be broadcast at frequent intervals on both R/T (PAN) and C/W (XXX).

On March 10 and 11 sightings of debris were made within a radius of 22.5 miles and at distances of between 61 and 94 miles from the LKP of the "BONNIE LOU II". Part of the debris recovered was the vessel's damaged and partly deflated liferaft with no one aboard, and a piece of plywood later positively identified as having been part of the wheel-house/dog-house of the "BONNIE LOU II".

The search and rescue operation, which continued until 1843 on March 13 1988, involved four tasked vessels and eight tasked aircraft. Fishing and other vessels traversing the search area were alerted by the broadcast Urgency (PAN) calls. The urgency broadcast was downgraded to a safety message at 1941 on March 13, 1988 some 30 hours after the recovery of the damaged liferaft by CCGV "SIR WILLIAM ALEXANDER".

A total of 12,166 square nautical miles were searched, 9000 of which were searched by aircraft during a total on-scene time by the tasked units of 156.2 hours.

A detailed account of the search and rescue operation is contained in Annex III.

3. The Vessel

The following description is based upon that of the almost identical sister vessel, "SCOTT G" and on evidence from previous owners and boatbuilders.

The yellow birch keel of the "BONNIE LOU II" was laid down in April 1964 at a shipyard in Cheticamp, Nova Scotia, and was the first vessel of such a length to be built at that shipyard.

The vessel was built according to specifications approved May 9, 1957 by the then Board of Steamship Inspection of the Federal Department of Transport.

She was constructed of yellow birch strakes on oak ribs below the waterline and 50 mm spruce strakes from the waterline to the sheer strake. The framework was generally 100 x 150 mm spruce. All underwater fittings were of galvanized steel.

The original slaughter-house and the wheel-house were constructed of 20 mm marine plywood on 43 x 70 mm pine frames.

The wheel-house was sited at a distance approximately one-third the length of the vessel from the bow, and was

flush with the maindeck. On the starboard side, extending to the side of the vessel, was an enclosed remote control area of bridge operation (dog-house) from where the skipper could monitor movements to and from the slaughter-house.

A wooden door, 1.22 m X 0.5 m, on the port side of the wheel-house gave access to the outside deck. This door had a sill 305 mm high.

At the forward end of the wheel-house was a companion-way down to the crew accommodation, inside which was a set of double-tiered bunks on either side at the forwardmost part.

A Lunenburg Foundry stove was sited at the port after corner and a further set of double tiered bunks at the starboard after corner. Beneath the floors amidships, was a 1,400 litre capacity fresh-water tank.

450 mm from the after bulkhead of the wheel-house was an access hatch to the engine-compartment which was beneath the slaughter-house. The access was 508 mm x 762 mm with a 76 mm non-watertight wooden coaming.

The vessel was equipped with a GM 8V-71 diesel engine and this engine was re-conditioned in 1987.

Also in the engine-compartment was a Lister engine for the operation of a fire and bilge pump. A weathertight bulkhead between the engine-compartment and the fish-hold was constructed of 2-ply double diagonal planks of 25 mm thickness with canvas between two layers.

A sliding door constructed of a single sheet of 16 mm plywood, 102 mm high x 51 mm wide led from the starboard after side of the wheel-house into the slaughter-house. At the base of this door, which was at maindeck level, was a 76 mm sill. Section 26.(1) of the Small Fishing Vessel Inspection Regulations requires the sill to be a minimum of 300 mm and Section 27.(4) requires the doors to be of strong construction and hinged.

No storm shutters were carried by the vessel, however, because she ventured more than 20 miles offshore, they were required under Section 27.(2) of the said Regulations (See Annex 1).

The slaughter-house was between the wheel-house and fish-hold bulkheads and extended to the port and starboard sides of the vessel. Two side doors, each 1.4 m x 1.8 m x 16 mm and strengthened on all edges with 50 mm x

100 mm timber, were hinged to open upwards at the retrieval area. When closed, the doors were secured by a 3 m length of 50 x 100 mm timber supported in steel brackets and four 9 mm galvanized steel pins, 150 mm in length which were inserted into holes to a depth of 75 mm. There were two holes at the base of the side doors and one on each side 230 mm from the base. The deck level in way of the side doors and the wheel-house door was 533 mm below that of the maindeck thus creating an athwartship well which was 2.08 m in length and which extended the full breadth of the vessel.

On either side of this welldeck area were two 50 mm scuppers through the ship's side planking at deck level for welldeck drainage.

Access from the slaughter-house to the maindeck aft was through sliding doors on the port and starboard sides, each 1.8 m high, 762 mm wide and 16 mm thick. The track of the doors was approximately 76 mm high, thereby affording a minimal sill.

Abaft and amidships of the slaughter-house was the fish-hold hatch which was 1.9 m x 1.3 m and had a coaming 482 mm high. The hatch was covered with a one piece, lift-off aluminum hatch cover with a 76 mm lip and fitted with a single wing-nut and bolt at each of the fore and after ends. Incorporated into the main hatch cover was a hinged access hatch 685 mm square, with a 57 mm lip, which opened to forward and had one securing wing-nut and bolt at the after end.

At the after end of the maindeck was a lazaret in which were two 2,200 litre fuel-oil tanks.

The bulwark strakes were 190 x 32 mm spruce, 635 mm high with 100 x 100 mm uprights, spaced approximately 610 mm apart, from the deck to the bulwark cap.

A freeing-port drainage space of 51 mm was common between all bulwark uprights, with the exception of those at the stem.

A liferaft was stowed atop the housework, which was 2 m high, on the starboard side approximately 3.65 m from the after access point, and a dory was stowed on the port side of the housetop. The painter from the liferaft was reportedly taped to the cradle and not secured. No hydrostatic release was fitted to the liferaft lashings and the vessel was not required to be so fitted under the present regulations. There seems to be a widely held belief that hydrostatic releases are

not suitable for smaller vessels due to the large amount of water that could be shipped in rough weather which may trigger the hydrostatic release resulting in the loss of the liferaft. However, as the liferaft on the "BONNIE LOU II" was stowed atop the wheel-house, this would probably be an unlikely occurrence under normal operating conditions.

The vessel had a reported cargo load-capacity of approximately 45 tonnes but appears to have been limited to 36 tonnes. Her outward passage cargo ice-load was generally between 12 and 15 tonnes.

Since her construction, the vessel never returned to the original shipyard. She was retained by the original owner for 19 years and during that time, was reportedly out of the water for maintenance on average every 8 months.

In 1981, hairline cracks were observed in the bulkhead between the engine-compartment and the forward accommodation. The affected planks were replaced and secured with galvanized boat-nails.

Reportedly, owner had no reason to doubt the good structural condition of his vessel when it changed hands in February, 1983.

The vessel was operated by the second owner until October 1983 when it was laid up for one year. In March 1985, the vessel sustained heavy weather damage to the bow section and repairs were carried out at a boatyard in Dover, NS. At that time, five strakes, forward of the engine-compartment and above the waterline, were replaced and, as the original square boat-nails were observed to be in poor condition, stainless steel screws were used as fasteners. Reports indicate, however, that although the boat-nails were corroded, three nail-pullers were broken in trying to remove them.

The butts from amidships to forward, from the waterline to the keel, were re-caulked. Although soft-plank was observed in the upper section of the hull and in the framing of the wheel-house, it was decided that repair-work to those areas was not of paramount importance at that time.

In October 1985, the vessel again changed hands and the new owner had hard plastic sheathing applied with stainless steel screws, to a section of the hull from 600 mm above the waterline to 900 mm below as a protection against ice damage. His observed opinion of the

underside of the hull at that time was that she was in good condition. The underwater butts were checked and appeared in good condition also.

The final owner of the "BONNIE LOU II" acquired the vessel in May 1987 and from that date until the final departure from Sambro, March 6, 1988, much repair-work was carried out and several components were replaced.

The vessel entered the Dartmouth shipyard July 13, and was hauled on to a marine cradle. During the ensuing 18 days, the hull was sand-cleaned, all underwater butts re-caulked, several areas of straking re-nailed and the entire underside re-painted, after which, six new anodes were affixed to the hull.

The original slaughter-house and dog-house were stripped off, and new houses were constructed of 20 mm plywood on frames of 43 x 70 mm spruce. The deck beams were of 75 x 150 mm spruce and the slaughter-house was secured through the deck with 15 mm through-bolts, 1.8 m in length at the forward end and 2.6 m aft.

Upon completion of all structural work, the vessel was completely re-painted, the top coat being green on the hull and white on the upperworks.

The engine was reconditioned and the vessel was completely re-wired and eight new 8V batteries were fitted.

A new steel mast and boom were fabricated and an aluminum hatchcover was fitted to the fish-hold.

Several items of electronic equipment were replaced with newer models including SSB radiotelephone, alternator, Raytheon R40 radar, Dytek power-supply, Sitex T100 radar and SSB antenna. Repairs were made to other various electrical and mechanical components. The most noteworthy of these was the auto pilot which had its hydraulic pumping system replaced by an electric pumpset and solenoid valves. The junction box was rewired and checked out. The compass and sensor were replaced as the existing compass was considered to be inappropriate for the size of the vessel.

New fire and bilge pumps and several items of lifesaving equipment were also placed aboard the vessel. These are covered under separate headings.

A Marine Surveyor from the Ship Safety Branch of the Canadian Coast Guard was in attendance during the execution of the foregoing maintenance and repair work.

During the ten months of new ownership, a total of $70,300 was spent on repairs and equipment for the vessel and evidence reveals that had the skipper required material for the vessel or repair work to be done, the owner would not hesitate to co-operate.

In addition to the foregoing approximately $2,000 of material and equipment was purchased and placed aboard the "BONNIE LOU II" for running repairs and maintenance work.

4. Inspection

Being a vessel in excess of 15 gross tons, but not in excess of 150 gross tons, the "BONNIE LOU II" was required to be inspected once every four years, as governed by paragraph 468.(1) of the Canada Shipping Act. In addition, should any structural alterations be carried out which may affect the seaworthiness of the vessel, they must meet the requirements of the Small Fishing Vessel Inspection Regulations and be inspected by a Marine Surveyor of the Ship Safety Branch of the Canadian Coast Guard.

A review of the Inspection record of the "BONNIE LOU II" reveals that quadrennial inspections were carried out as follows:

Initial inspection, May 20, 1964 at Cheticamp, NS;
June 11, 1968 at Point Tupper, NS;
June 21, 1972 at Port Hawkesbury, NS;
June 18, 1976 at Port Bickerton, NS;
July 16, 1979 at Dartmouth, NS, and
February 2, 1984 at Sambro, NS.

There is no record of certification for the period July 11, 1983 to February 2, 1984 although it was reported that the vessel was in service until October, 1983 when it was laid up until February, 1984.

Intermediate inspections were conducted June 21, 1968 at Halifax and July 30, 1976 at Dartmouth.

The "BONNIE LOU II" underwent a quadrennial inspection in January/February 1984 and an SIC 29 issued February 2, 1984 was valid until February 1, 1988.

It is the responsibility of a vessel owner to recognize and correct any defects in the vessel which could invalidate the SIC and, at the same time, to advise a Ship Safety Officer of such correction if it affects the seaworthiness of the vessel.

Similarly it is the responsibility of a vessel owner to engage the services of a Ship Safety Officer to ensure a vessel is operating with a valid SIC.

The "BONNIE LOU II" departed from Sambro January 28, 1988 and returned February 5, three days after the expiry of the SIC 29.

It was reported that during that particular trip the vessel was leaking into the engine compartment, the fish-hold and the lazaret. When the vessel dry-docked February 8, the leak in the fish-hold was patched and butts beneath the fish-hold, fo'c'sle, and engine compartment were caulked. A marine surveyor was in attendance during the day that the repair work was carried out and the SIC 29 was extended February 8 to expire April 8, 1988.

5. Possible causes of the casualty

It is acknowledged that the precise cause of the loss of the vessel is not known. It is possible that she had drifted, hove-to in the north-westerly gale, into the US Atlantic Seaboard/Europe Great Circle track and was run down by an unknown vessel during conditions of poor visibility. However, the master of all deep-sea vessels known to have been in the vicinity of her LKP, and within a substantial radius of that position, have indicated that no radiotelephone calls were heard and no vessel which would fit the description of the "BONNIE LOU II" was sighted. If we are to believe that aerial 'low confidence' sighting of a capsized green hull, it is unlikely that the "BONNIE LOU II" was struck by another vessel.

Without evidence or testimony from a survivor, it is impossible to indicate the exact cause of this tragety. However, certain facts have been established without doubt and these can all be considered to be contributory factors:

- weather conditions;
- age of the vessel;
- inherent weaknesses in certain aspects of the construction of the vessel, and
- lack of experience of the crew members in offshore fishing.

There is positive evidence of prior heavy weather damage

and of storm conditions. A possible sequence of events of the loss of the vessel in the storm conditions is, therefore, examined in Analysis 6.

A radiotelephone conversation indicated that the starboard slaughter-house door had been broken by heavy seas and that water was in the engine-compartment. No clarification was made as to whether it was the slidign door or the retrieval doors or whether the engine-compartment was taking water from below the waterline, through the deck or through the coaming of the access hatch in the wheel-house. Whichever door had broken, it is difficult to imagine satisfactory repairs being carried out in 45 minutes considering the vessel must have been reacting violently to the weather conditions.

It should be noted that although there were three radiotelephone sets aboard the vessel, no distress message was received. Judging from previous similar casualties, this is not unusual; either the equipment becomes wet, the batteries short out or the antennas short out in the storm conditions.

Reportedly, the "BONNIE LOU II" was sound and well handled. However, any small vessel employed offshore in exposed waters is operated at some risk, and any insignificant or minor dificiency which in normal operation is not apparent or give sno cause for concern can, in extreme conditions, initiale a sequence of events which could rapidly culminate in the loss of the vessel.

Debris recovered after the casualty and identified as parts of the deck shelter superstructure, confirms the occurrence of structural damage and eventual disintegration, however it cannot be determined whether this occurred before, as, or after the "BONNIE LOU II" sank.

6. Stability

As a small fishing vessel of more than 15 gross tons, built before July 6, 1977, and not engated in fishing for herring or capelin, the "BONNIE LOU II" was not required to comply with the intact stability requirements of Part I, Section 29(1) of the Small Fishing Vessel Inspection regulations (See Annex I). When the "BONNIE LOU II" and her only near-sistership "SCOTT G", were completed, records of the finished hull lines were not retained by the builder and no basic design data or hydrostatic particulars were ever prepared. Neither vessel was the subject of an inclining experiment and detailed transverse stability characteristics were not

calculated, consequently, the precise stability and trimmed condition of the "BONNIE LOU II" prior to her loss is not known.

A loading condition survey and rolling period test were carried out on the "SCOTT G", May 19, 1988 to provide data from which estimated initial transverse stability characteristics of the "BONNIE LOU II" could be derived. (See Annex IV)

The test showed that the "BONNIE LOU II" had and retained an adequate initial transverse stability at 1800 March 8, after having been at sea for some 60 hours.

In view of the radio messages received prior to her loss describinb some structural damage and flooding, the post-casualty stability review focused upon the detrimental effects of the heavy seas which were reportedly shipped and retained on deck, together with the likelikood of subsequent downflooding and foundering.

It is apparent from the outline general arrangement (See figure 1) that any heavy seas shipped from starboard, having entered the enclosed slaughter-house by way of stove-in bulkhead sliding doors or, more particularly through open or unsecured ship side fishing doors, would be retained in that structure and accumulate in the welldeck. The area of the deck shelter and volume of the welldeck are such that a 'nominal' layer of shipped water only 150 mm above maindeck level would weigh some 10.3 tonnes. The weight of this shipped water would lower the vessel's freeboard some 140 mm, and also reduce the GMt to approximately 0.82 metres.

The concurrent free-surface effect of the shipped water would also cause a drastic deterioration of the transverse stability, and it is calculated that the GMt, which is indicative of a vessel's initital stability, would have been reduced to only 82 mm.

It is calculated that the four 50 mm scuppers fitted in the well deck required six and one half minutes to clear the well of water provided that they remained clear of obstructions and above sea level. Reportedly it was normal practice to stow tubs of long-line on the port side of the vessel and also in the well deck and it is considered likely that the flow of water to the port side scuppers was thus impeded, significantly increasing the time required to clear the well of water.

It would appear that while the "BONNIE LOU II" was in

the highly vulnerable condition indicated, the dynamic heeling effects produced by the weight and impetus of additional heavy seas shipped from starboard, further lowered and overcame her intitial ability to recover. When heeled toward the limiting range of positive stability the vessel, because of the reduced righting moment and gravitation of shipped water to port, remained heeled over with the welldeck scuppers immersed. The reduced efficiency of the scuppers increased the time required to clear the shipped water off the deck, retarded the vessel's recovery and caused the sill of the port side wheel-house door to remain submerged. The water shipped in the wheel-house subsequently downflooded into the engine-compartment and forward accommodation space by way of the low 65 mm sill of the engine-compartment hatch on the port side of the maindeck and through the open accommodation access, preventing the vessel's recovery, and continued downflooding until all reserve buoyancy was lost and the vessel foundered.

7. Freeing-port requirements

Regulatory requirements for the minimum area and location of freeing-ports applicable to small fishing vessels are included in Section 29.1(1) of Part 1 of the Small Fishing Vessel Inspection Regulations (See Annex I). It should be noted that applicability of the above section is distinct from that of Section 29, which applies only to stability, and that revision of the Regulations currently in hand will renumber these two sections, clearly separating their respective applications.

Freeing-port areas

The location and dimensions of the freeing-ports and scuppers arranged for clearing shipped water from the main and welldecks of the "SCOTT G" are shown in Fig. 1, and reportedly are similar to those of the "BONNIE LOU II" at the time of the casualty.

The regulatory minimum freeing-port area calculated for each side of the maindeck-well bounded by the transom, port and starboard bulwarks and after end of the deck shelter, is some 0.9 m^2, while the actual area fitted is approximately 0.3 m^2. Thus, the "SCOTT G" does not meet the regulatory requirement in this respect and presumably, neither did the "BONNIE LOU II".

The slaughter-house deck shelter abaft the wheel-house is not fitted with weathertight doors at its after end

and, of necessity, this area of working deck is only partially sheltered and is open to the weather, particularly when the side fishing doors are open to starboard during fishing operations. Consequently, the slaughterhouse shelter is not always completely enclosed and, in practice, the working deck exposed to the weather effectively extends from the transom to the after end of the wheel-house. Based on such a maindeck-well length, the minimum regulatory freeing-port area per side is calculated to be approximately 1.0 m^2, while the actual areas fitted to port and starboard are 0.325 m^2 and 0.372 m^2 respectively.

The clear area available for freeing shipped water is significantly increased when the side fishing doors on the starboard side of the vessel are open. However, because their lower edge is at maindeck gunwale level, the vessel's effective freeboard is reduced and consequently the likelihood of shipping water is actually increased. The welldeck is located some 0.56 m below the maindeck and because of the relatively low freeboard in way of the existing drainage scuppers, particularly when the vessel is heavily loaded, installation of larger freeing-ports is impractical.

Because of the coincident fore and aft location of the side fishing doors, the full width well and the low freeboard in way of the welldeck scuppers, the likelihood of shipping and retaining seas in the well is increased, and the ability to rapidly shed water is limited.

The transverse stability of the vessel would be significantly reduced due to the free-surface effect of any water shipped and retained in the well, and she would remain in a highly vulnerable condition until it was completely cleared. In general, few fishermen fully understand free-surface effect and fewer appreciate the substantial loss of transverse stability when water, even a few inches, is shipped and retained on deck. Coupled with the loss of effective waterplane area when the maindeck edge is submerged, the effects can be disastrous.

8. Pumping arrangements

The vessel was reportedly equipped with four fire and bilge pumps and one hand bilge pump with a total capacity of 16.5 l/s.

A 51 mm rotary type, pump operated off the main engine, had suctions to all three compartments - forward

accommodation, engine compartment and fishhold. The control for this pump was in the engine compartment.

Two 32 mm centrifugal pumps were operated from the alternator and one from a Lister engine and each had suctions to all compartments. The electrically operated pump had a control in the wheel-house.

A 51 mm rotary type pump was operated from a portable Honda gasoline motor which was stored in the wheel-house area and readily accessible.

9. Lifesaving equipment and fire-fighting appliances

The "BONNIE LOU II" departed from Sambro, March 6 with the following equipment reportedly on board:

1	15-person Dunlop inflatable liferaft,
1	6-person 3.9 m wooden dory,
1	lifebuoy with line,
1	lifebuoy with automatic light,
6	approved keyhole lifejackets,
12	hand flares, delivered February 9, 1988,
6	rockets, delivered February, 9, 1988,
1	fire-axe, delivered February 9, 1988,
2	4.5 kg dry chemical fire extinguishers delivered February 8, 1988,
1	1.1 kg dry chemical fire extinguisher delivered February 8, 1988, and
1	22.7 kg CO_2 smothering system in engine compartment, recharged February 8, 1988.

This equipment is in compliance with The Small Fishing Vessel Inspection Regulations and The Lifesaving Equipment Regulations.

The "BONNIE LOU II" did not carry an EPIRB or an EPIB nor was she required to by regulation. However, had she carried either, the transmission from such may have alerted SAR authorities when the vessel was initially in distress.

No immersion suits were carried and they are not required to be carried under the existing regulations. It would be purely speculative to say that they may have saved the lives of the crew had they been on board, not knowing the circumstances surrounding the loss of the vessel; but, with conditions allowing, the wearing of immersion suits may have increased the chances of survival.

10. Liferaft

Due to the badly damaged condition of the recovered liferaft, a special study focussed on this aspect.

The "BONNIE LOU II" normally carried a Dunlop Seafarer 'A' Pack, 10 person inflatable liferaft No. DR-2-20553 but this liferaft was delivered to a liferaft service centre for routine inspection and testing February 8, 1988.

At that time, a loaned liferaft was delivered to the "BONNIE LOU II" in lieu of the regular raft, which is a normal procedure during servicing. The loaned raft was a Dunlop Seafarer 'A' pack 15-person bearing the serial number DR/3/26470 and the inflation cylinder bore the engraved number 434576 but also bore the number of the liferaft. This particular liferaft was, according to an amended date on its certificate, due a routine inspection March 30, 1988 and, as the inspection on the original liferaft from the "BONNIE LOU II" was completed February 19, 1988, it was anticipated that the two would be exchanged again prior to that expiry date.

Although the "BONNIE LOU II" returned to port following February 19, 1988 there was a communications failure between the owner of the vessel and the liferaft centre which resulted in the loaned liferaft being still aboard March 6. The age of the loaned unit was 15 years and that of the original liferaft was 21 years.

A directive was issued by the Superintendent of the Equipment and Operational Safety Branch of the Canadian Coast Guard, Ottawa, March 13, 1987 regarding specific tests to be carried out on liferafts over 10 years old. Such tests had to be conducted in the presence of a marine surveyor and, on the tenth anniversary following the date of manufacture, included inflation by means of its gas cylinder whilst still in the lower portion of the canister, subjecting the raft to an overpressure test of 7 kPa whilst checking seams and fabric. Five additional procedures were also required to be carried out. The loaned liferaft had been subjected to the

complete procedure March 30, 1987 and no defects were found.

When a liferaft undergoes annual servicing, it is opened up from its container, rolled out and inflated. The provision pack is removed and the liferaft undergoes a manometer test being subjected to a pressure test of 13.79 kPa. The relief valves are checked for proper reseating. All provisions are checked and any items which have deteriorated or which are close to their expiry date, are replaced. The CO_2 cylinder is taken out, visually inspected, weighed and then the entire raft unit is repacked according to manual specifications.

11. Retrieval and Initial Examination of Liferaft

The liferaft was sighted at 1305, March 12 by the "SIR WILLIAM ALEXANDER" and retrieved at 1400 the same day. Weather conditions at the time were westerly winds between 40 and 45 knots with seas in excess of 9 m. It was heavily overcast creating a dark day and the liferaft was only approximately 250 metres away when it was first sighted. This was due to the fact that the orange canopy was missing and it was the black flotation chambers which were seen.

Due to the heavy seas, it took the vessel a full ten minutes to turn about and the master manoeuvred his vessel's stern into the seas and alongside the liferaft. A prefabricated set of grappling hooks of round steel was used to retrieve the liferaft.

The grappling hook was dropped among a tangled mass of what was believed to be the drogue line and once that line was accessible, a line from the ship was secured to it and the liferaft was winched on deck. The appearance of the liferaft can be likened to a pretzel as it had virtually tied itself into a knot and the drogue and quoit lines were all tangled together.

Due to the weather conditions and the need for a speedy return to the search, a quick check was made of the raft for identification purposes but nothing was revealed. The inflation cylinder was disconnected from the liferaft and it was from the number appearing on the cylinder that the liferaft was positively identified as being that from the "BONNIE LOU II".

It was decided to stow the liferaft in the fo'c'sle-head store but that meant deflating the remaining inflated chamber. A brief examination was made for the plug but

as it could not be immediately located and speed was of the essence, a 25 mm cut was made in the chamber with a pocket knife.

The liferaft was subsequently landed at Mulgrave and transported to the Canadian Coast Guard Base, Dartmouth where a condition examination was carried out by a Marine Casualty Investigations Officer and the manager of the liferaft centre.

This examination revealed that the rescue quoit line, the drogue line, the boarding ladder, the knife line and the inflation pump were wrapped around the upper chamber and the canopy arch.

The seam of the lower chamber had separated for a length of approximately 2.5 m and all but a small section of the canopy had been lost. One side of the arch support had been pulled apart from the upper chamber.

The painter had been cut with a knife approximately one metre from the liferaft.

During the examination, an attempt was made to inflate the liferaft using the foot-pump but the knife-cut in the upper chamber prevented total inflation. The plug itself was still in and tight.

The CO_2 cylinder still had its high-pressure hose attached and the inflation hose system of the liferaft was intact and tight. The cylinder, which was disconnected when the liferaft was retrieved, had been fired but the operating cable was missing.

During the course of the investigation, and in view of the condition of the liferaft when retrieved, it was decided that a complete and thorough analysis of the liferaft and its contents be carried out. It was felt that this action would, in addition to indicating the liferaft's condition, obtain evidence to aid in determining if the liferaft had been boarded by crew members of the "BONNIE LOU II".

An independent study was therefore performed by the Department of National Defence at Maritime Command Headquarters, Halifax and a precis of the findings of the study follows; (Supplementary information may be found in Annex V).

The general condition of the inflation equipment salvaged was found to be good and there was no sign of fabric deterioration in the material of the liferaft.

The liferaft was not patched nor had repairs been carried out on the seams. No evidence was found to indicate that the liferaft had become entangled with foreign object nor that it had been inflated on the deck of the "BONNIE LOU II".

Due to the age of the liferaft, it was further decided that the adhesive used should undergo laboratory analysis.

To determine if failures may have resulted from the use of an unspecified adhesive, samples of the adhesive from the failed joints and from unfailed joints in other areas of the liferaft were analyzed. Tests conducted revealed that the adhesive composition was similar in all areas, that it was both appropriate and that it conformed to the liferaft manufactuer's specifications.

There was a possibility that the failure of the lower buoyancy chamber might have initiated in an area close to that area where the carbon dioxide/nitrogen gas is introduced to inflate the liferaft.

A frost barrier was found attached to the inner side of both upper and lower buoyancy chambers. The placement of the barrier however, was not symmetrical about the inlet valve and differed between the upper and lower chambers. Thus, there were approximatley 40 cm of uninsulated material in the immediate vicinity of the inlet in both chambers.

The mechanical properties of elastromeric materials, such as liferaft fabric and adhesive, are sensitive to changes in temperature. Discharge of the inflating gas mixture causes a cooling effect which may affect the mechanical properties of these materials. Adhesive joints in the area of the gas inlet, where no frost barrier was located, might be expected to be affected by the cooling.

From the evidence obtained, it appears that the liferaft aboard the "BONNIE LOU II" complied with the Standards for Inflatable Liferafts (1974) with the exception of the required marking on the liferaft unless these markings were on the missing canopy.

12. Deployment of liferaft

There is evidence conducive to the belief that survivors boarded the liferaft:

- although the survival pack was missing, the Bee

Hive pump, which is reported to have been installed inside the survival pack was recovered;

- the two sea drogues (sea anchors) should have been wrapped around the two paddles and secured with the drogue lines. As the paddles were missing, the drogues could have been removed by survivors, although it is not uncommon for the drogue lines to become separated once removed from their stowage position;

- no knot was found in the survival pack securing webbing. As the webbing is quite slippery, it could have loosened itself or it could have been undone by survivors;

- the painter line appears to have been cut with a knife 1.2 m from the liferaft and the liferaft knife had been removed from its stowage patch. This could indicate that the liferaft had inflated and had been boarded;

- if the painter was not cut the painter patch should have separated at a pull a 2,000 lb (907 kg) as per manufacturer's design, and

- the external grab line anchor patches were pulled from between the buoyancy tubes by an outside force.

The liferaft was probably inflated in the sea as there is no evidence that the raft was inflated on the ship's deck. Usually a raft will sustain damage when it is inflated from its container on a hard surface. Scratches and abrasions are usually evident on the lower buoyancy tube, outer sea floor and especially the CO_2 cylinder procket. In this case no such abrasions or scratches were present in these areas.

13. Other Vessels

Although, no doubt, other fishing vessels in the same general area weathered the storm, it is known that the:

"HALF RASPY", 56 gross tons, built in 1982;
"JOHNNY AND SISTERS", 91 gross tons built in 1978, and
"WET & WILD", 85 gross tons, built in 1982

successfully survived the storm without undue difficulty.

14. Debris

Seven pieces of debris were retrieved by "NARWHAL" and these consisted of six pieces of 19 mm plywood and one high-flyer. Of the plywood, four pieces had a clean separation whilst two were torn from their other members.

There is no concrete evidence that some of the debris was in fact, from the "BONNIE LOU II" but one piece was definitely identifiable and was confirmed by ex-crew members as being part of the wheel-house structure. Further, an ex-crew member who was aboard the vessel during October/November 1987 reported that the "BONNIE LOU II" sought refuge in Trepassey harbour, Avalon Peninsula, Newfoundland during severe weather conditions.

She remained in the harbour from October 29 until November 3, and the deckhand had marked on the bulkhead of the dog-house the dates, the name of the port and then had drawn a 'stickman'.

15. Comments by Previous Crew Members

Evidence was given as to the frequent clogging of the slaughter-house scuppers with bait and fish residue, however, this is not unusual for vessels of this class.

On the evening of March 5, the "BONNIE LOU II" was boarded at Sambro and checks were made to the pumps to ensure that the bilges were clean. Unusual vibration of the vessel was noted when the Lister engine was running to operate the bilge pump.

Adverse comments were received regarding the suitability of the sliding doors on the port and starboard after end of the slaughter-house. It appears that the doors were invariably left open for access purposes. However, when they were closed, they had to be forced in their tracks due to the wood having swollen. The inside lower track guides were higher than the outside guides, the upper tracks being of the same size on each side.

Indication was given that some sections of the deck planking were rotten and that water entered the fish-hold area from the deck above. In certain areas of the deck, 75 mm lag screws used to secure the uprights for the tub sectionals were able to be pulled out of the deck and eventually through bolts with washers had to be used to secure the brackets to the deck.

Reference was also made concerning a heavy head-on striking of the dock at Sambro three months prior to this casualty. That incident was never reported to either the owner or the Marine Casualty Investigations branch of Transport Canada, and therefore went un-examined. The only damage revealed was that the engine had shifted on its bed and that had been re-aligned by another crew member. This occurrence took place some time after the vessel had left Dartmouth Marine slips.

16. Personnel

In a fishing community, it is not unusual for family members to begin their fishing careers at a very early age. Such was the case with three of the missing and one of the three also served for a year and a half with the Royal Canadian Navy. However, in all their time spent fishing, none of the missing had previously experienced off-shore fishing during the winter months.

The skipper did not hold a fishing-master's certificate nor was he required to by regulation. He did not hold a Radiotelephone Operator's Restricted Certificate (Maritime) as required by the Radio Act and the General Radio Regulations. He had been at sea for ten years and joined the "BONNIE LOU II" in January 1988.
None of the other crew members held a certificate nor were they required to by regulation. Three of them joined the vessel in December 1987 and one in February 1988.

Findings

The loss of the "BONNIE LOU II" and her five man crew occurred in an unknown position, east and south of Sable Island some time after 1845, March 8, 1988. The cause of the loss is not known, but it appears likely that extreme adverse weather was the major contributory factor.

Accepting the theory that the vessel was overwhelmed, the following could also be considered as contributing factors:

- the vessel did not seek shelter when a gale warning was issued nor when the gale warning was upgraded to a storm warning;

- the crew had limited experience of off-shore fishing;

- the slaughter-house was constructed in such a way as to be unsuitable for heavy weather conditions;

- the four scupper discharges in the welldeck were insufficient to allow a speedy clearance of any shipped water in that area;

- the starboard wheel-house door had a low sill which would permit early entry of water into the wheel-house and subsequently into the engine-compartment and accommodation area, and

- water shipped in the well would create a free surface condition which would have substantially reduced her transverse stability characteristics, thereby rendering the vessel extremely vulnerable.

Other Findings

Compared to the majority of the fleet, the hull of the vessel could be considered to be old for fishing in that area during the weather conditions experienced.

The vessel had not had a detailed Ship Safety inspection for more than four years.

No distress call was received by any Coast Guard Radio Station or by any vessel known to have been in the area.

The "BONNIE LOU II" carried neither EPIRB nor EPIB. Although they are not required by regulation the transmission from such may have alerted SAR authorities to the distress.

There was no daily reporting regime in place which may have alerted the owner's representative and subsequently SAR to the distress.

The liferaft was determined to have met the manufacturer's specifications and Coast Guard requirements at the time of deployment.

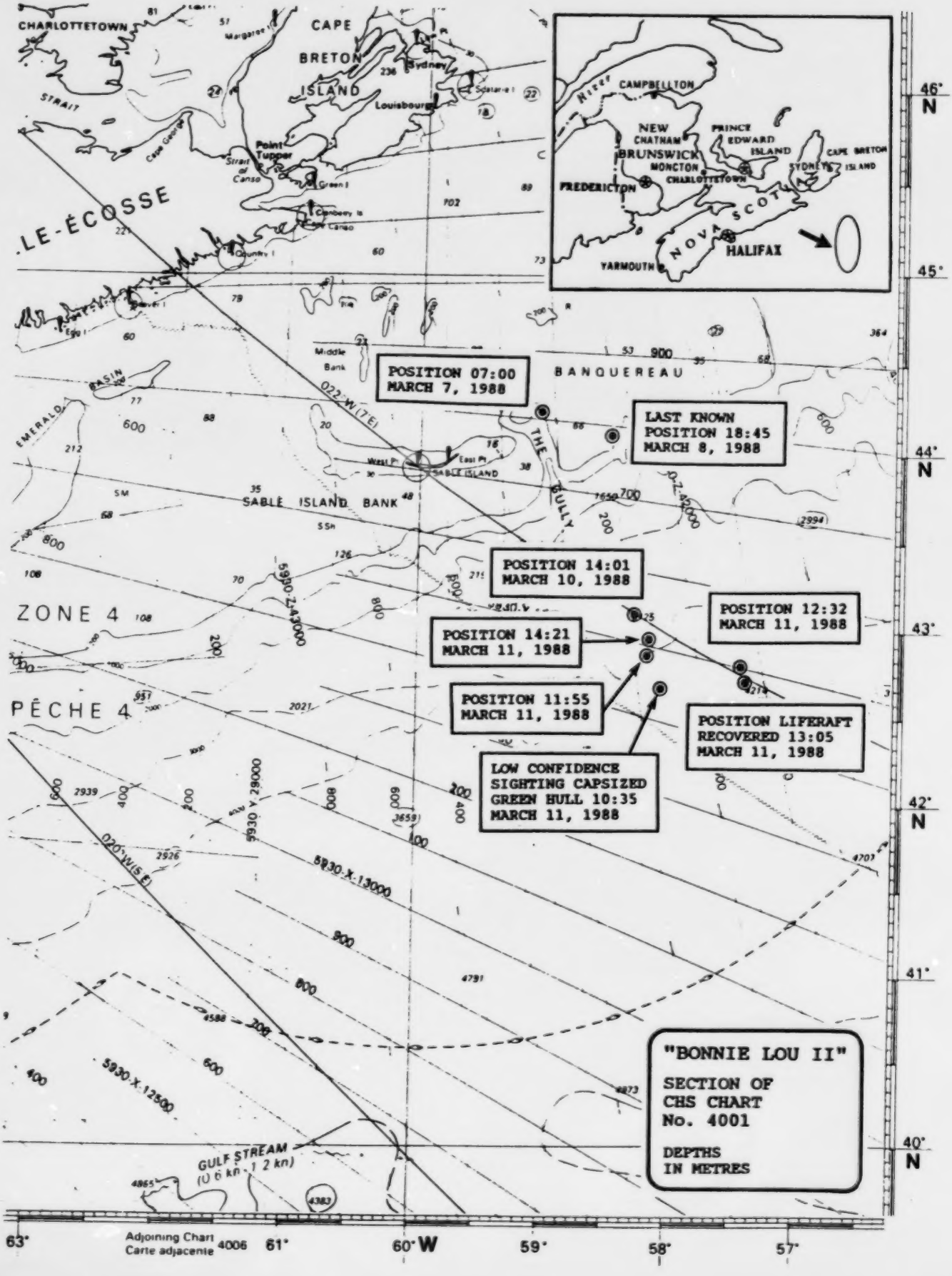
An examination of the condition of the liferaft indicated that it was highly probable that it had been boarded by survivors.

MARINE CASUALTY INVESTIGATIONS
TRANSPORT CANADA
110 O'CONNOR STREET
OTTAWA, ONTARIO
K1A 0N5

JANUARY 1989

Abbreviations

CF	Canadian Forces
CGRS	Coast Guard Radio Station
CSS	Coordinator Surface Search
C/W	Communications wave (Radiotelegraphy)
DFO	Department of Fisheries & Oceans
EPIB	Emergency Position Indicating Buoy
EPIRB	Emergency Position Indicating Radio Beacon
GMt	Transverse Metacentric Height
LKP	Last known position
OSC	On-scene commander
R/T	Radiotelephony
RCC	Rescue Coordination Centre
SAR	Search and Rescue
SIC 29	A Steamship Inspection Certificate
SSB	Single side-band
Tr	Observed Rolling Period
USCG	United States Coast Guard
VHF	Very high frequency


CHARLOTTETOWN
CAPE BRETON ISLAND
Sydney
Louisbourg
Point Tupper
Strait of Canso
Cape George
Green I
Canso
Country I
Margaree I
STRAIT
LE-ÉCOSSE
Middle Bank
BANQUEREAU
POSITION 07:00
MARCH 7, 1988
LAST KNOWN
POSITION 18:45
MARCH 8, 1988
POSITION 14:01
MARCH 10, 1988
POSITION 12:32
MARCH 11, 1988
POSITION 14:21
MARCH 11, 1988
POSITION 11:55
MARCH 11, 1988
POSITION LIFERAFT
RECOVERED 13:05
MARCH 11, 1988
LOW CONFIDENCE
SIGHTING CAPSIZED
GREEN HULL 10:35
MARCH 11, 1988
EMERALD BASIN
SABLE ISLAND
SABLE ISLAND BANK
THE GULLY
022°W(7°E)
020°W(8°E)
5930 Y 29000
5930 X 13000
5930 X 12500
ZONE 4
PÊCHE 4
GULF STREAM
(0.6 kn - 1.2 kn)
"BONNIE LOU II"
SECTION OF
CHS CHART
No. 4001
DEPTHS
IN METRES
Adjoining Chart
Carte adjacente 4006
NEW BRUNSWICK
PRINCE EDWARD ISLAND
CAPE BRETON ISLAND
NOVA SCOTIA
CAMPBELLTON
MONCTON
FREDERICTON
CHARLOTTETOWN
SYDNEY
HALIFAX
YARMOUTH
46° N
45°
44° N
43°
42° N
41°
40° N
63°
61°
60° W
59°
58°
57°

F.V. 'SCOTT 6'.

OUTLINE GENERAL ARRANGEMENT.

(F.V. BONNIE LOU II, SIMILAR).

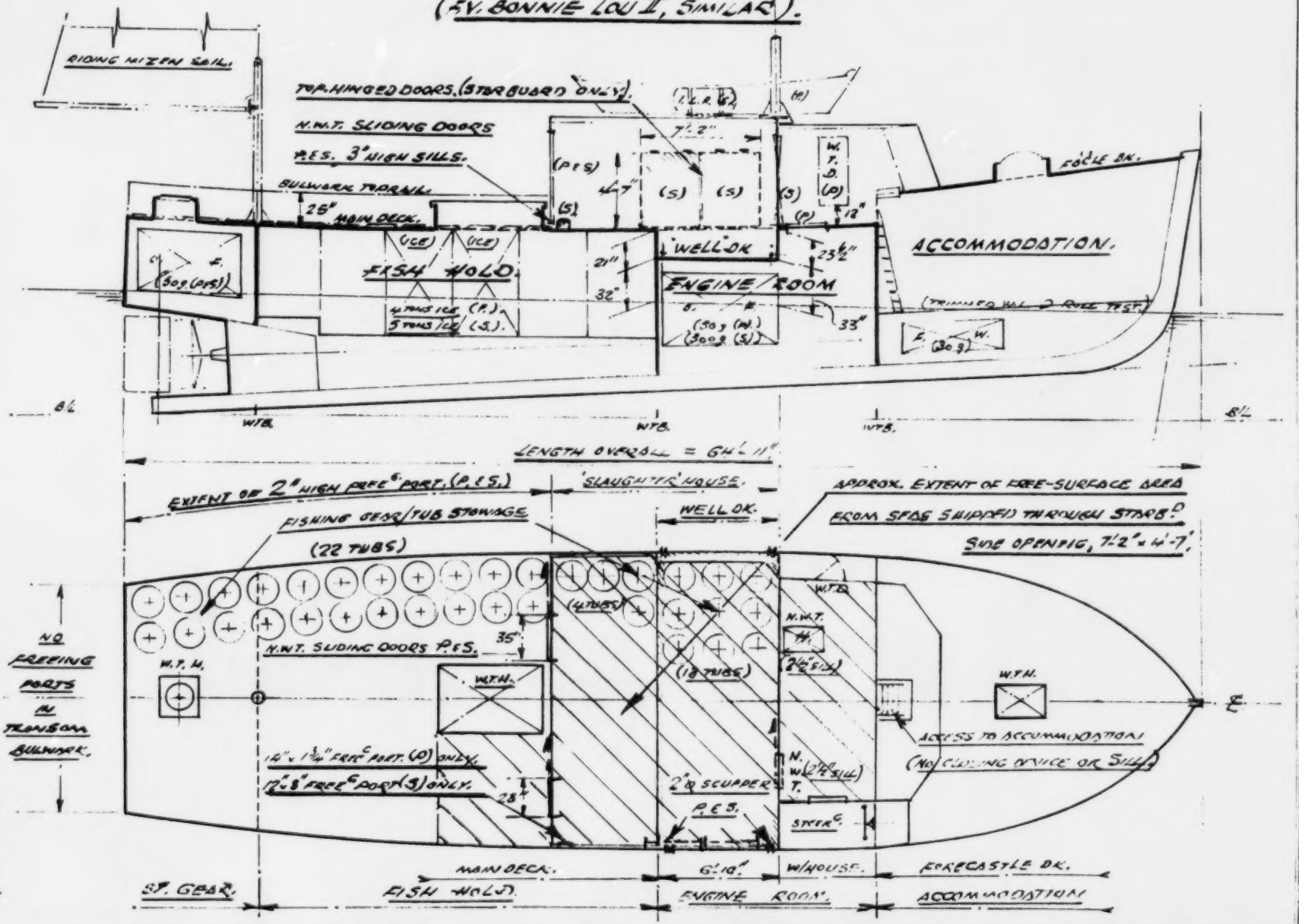
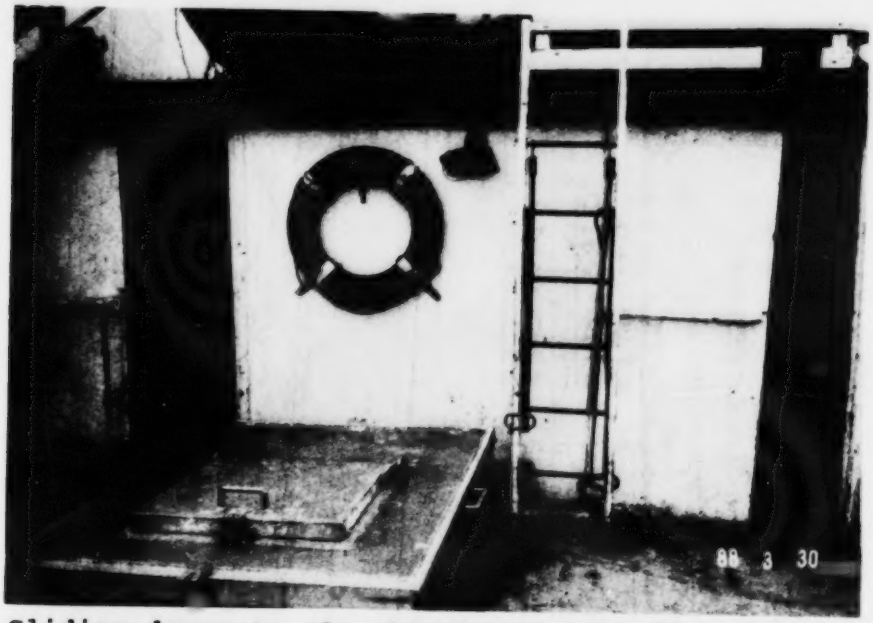


FIGURE No 1.

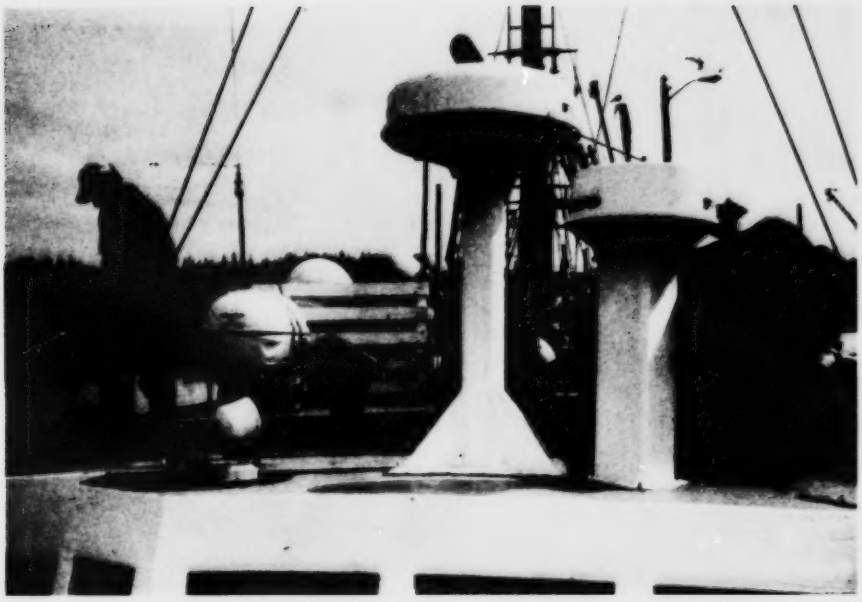
"SCOTT G" - Sister vessel to "BONNIE LOU II" - Note sill at wheel-house door and freeing areas at after bulwark spaces. Well-deck scupper discharges can be seen on hull.

"SCOTT G" - Bateau jumeau du "BONNIE LOU II" - remarquez le seuil de la porte de la timonerie et les sabords de décharge dans le pavois arrière. On peut voir les dalots du pont à coffre dans la coque.



Sliding doors to slaughterhouse-note fish-hold, the low sill and lack of reinforcement of plywood doors.

Portes coulissantes de la salle d'éviscération - remarquez le seuil bas et l'absence de pièce de renforts en contre-plaqué.

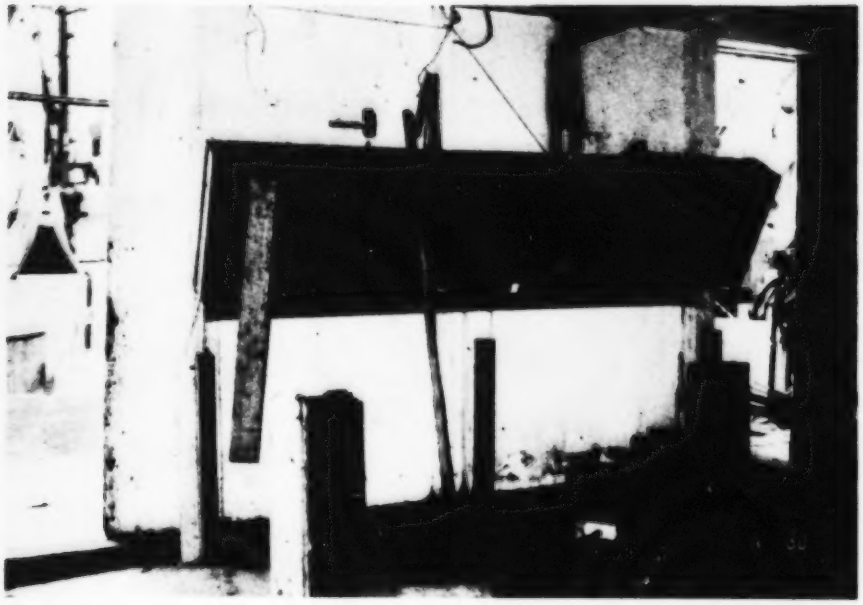


Liferaft forward of float container.

Radeau de sauvetage à l'avant du coffre à flotteurs.

Freeing areas at bulwarks. The decks and housework of the "SCOTT G" had been laminated with reinforced plastic whereas the "BONNIE LOU II" had not.

Sabords de décharge au niveau du pavois. Les ponts et la structure du "SCOTT G" ont été recouvert de plastique renforcé alors que ceux du "BONNIE LOU II" ne l'avaient été.

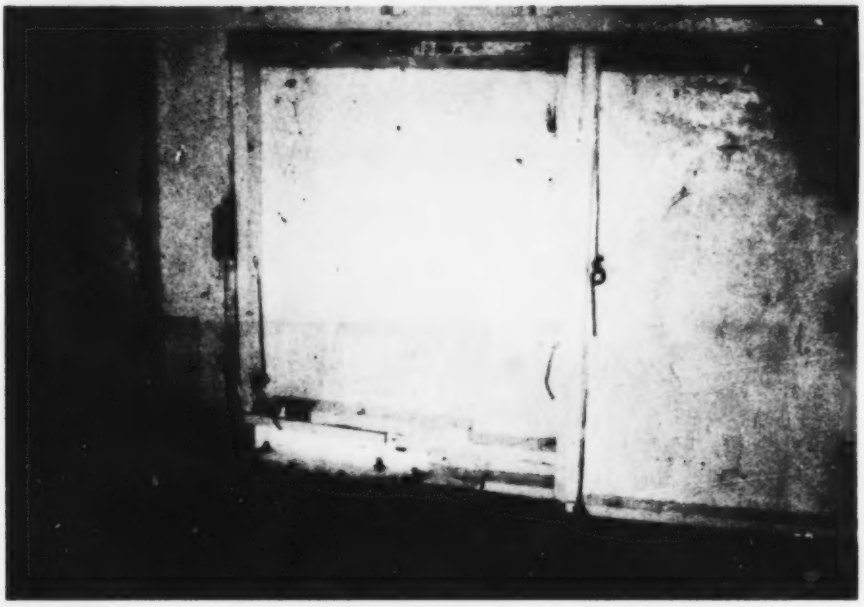


Sliding doors to slaughterhouse and work area inside slaughterhouse.

Portes coulissantes de la salle d'éviscération et surface de travail à l'intérieur de la salle d'éviscération.

Well-deck area showing one of two scupper discharges on each side.

Intérieur du pont à coffre. On voit un des deux dalots (il y en a deux de chaque côté).

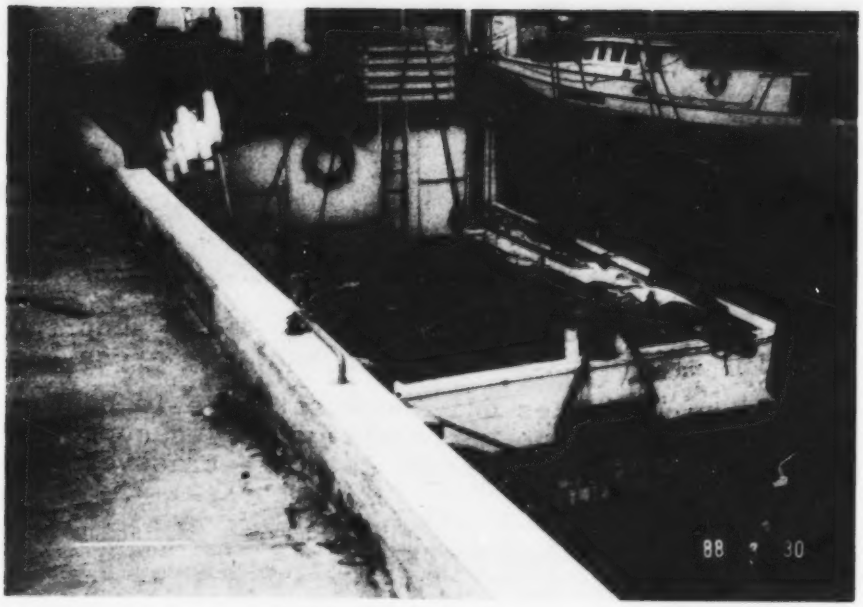


Side doors which open upwards - Note securing pins and brackets (at each end) for cross bar.

Portes latérales qui s'ouvrent vers le haut - remarquez les goupilles de verrouillage et les supports (à chaque extrimité) de la barre transversale.

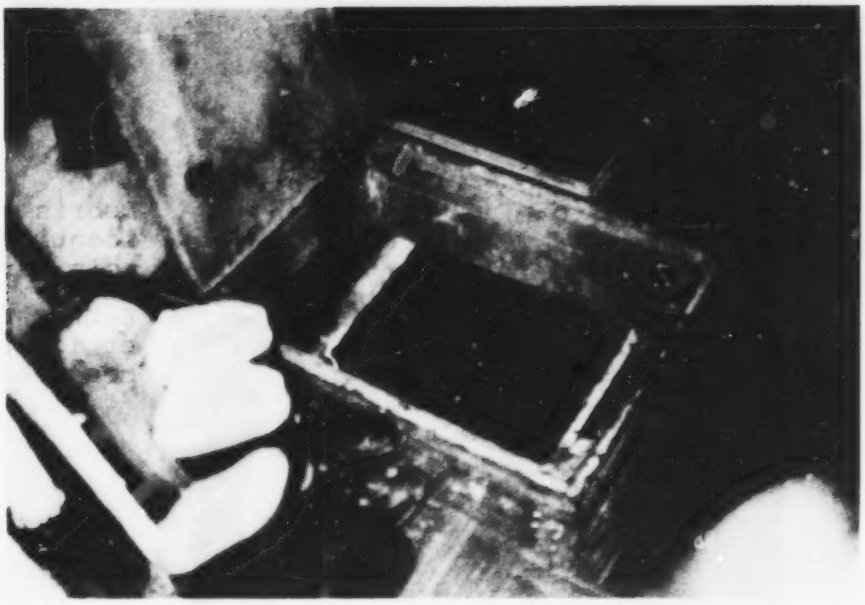
Access to wheel-house from slaughterhouse-note low sill at door base inside at main-deck level.

Accès à la timonerie depuis la salle d'éviscération - remarquez le seuil de la porte peu élevé à l'intérieur au niveau du pont principal.



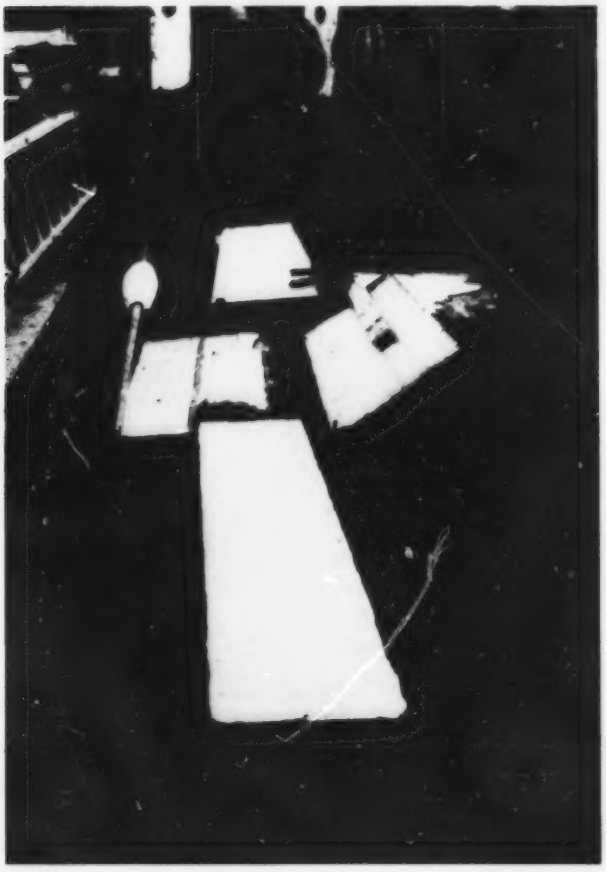
View showing tubs with long-lines on port side, fish-hold, sliding doors to slaughter-house and access ladder to wheel-house top. Liferaft is forward of float container.

Vue de l'arrière on voit les bacs de palangre du côté bâbord, la cale à poisson, les portes coulissantes de la salle d'éviscération et l'échelle menant sur le toit de la timonerie. Le radeau de sauvetage se trouve à l'avant du coffre à flotteurs.



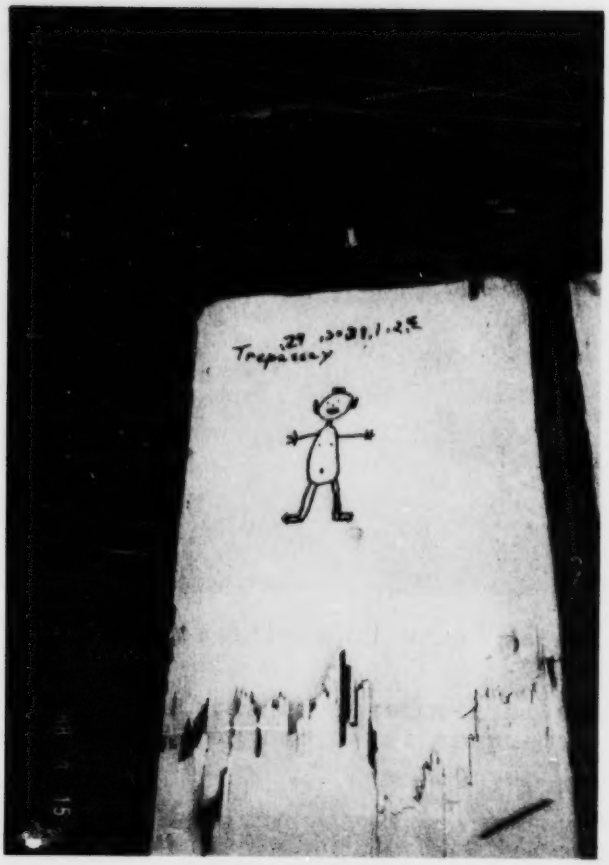
Hatch from wheel-house to engine compartment - note low coaming.

Descente dans la timonerie menant au compartiment machines - remarquez le surbau peu élevé.



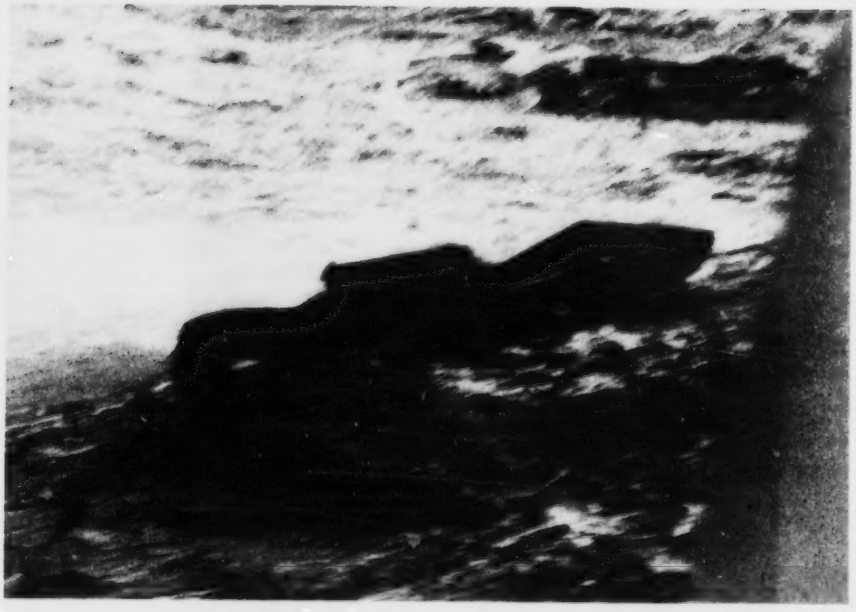
Debris recovered.

Débris récupérés.



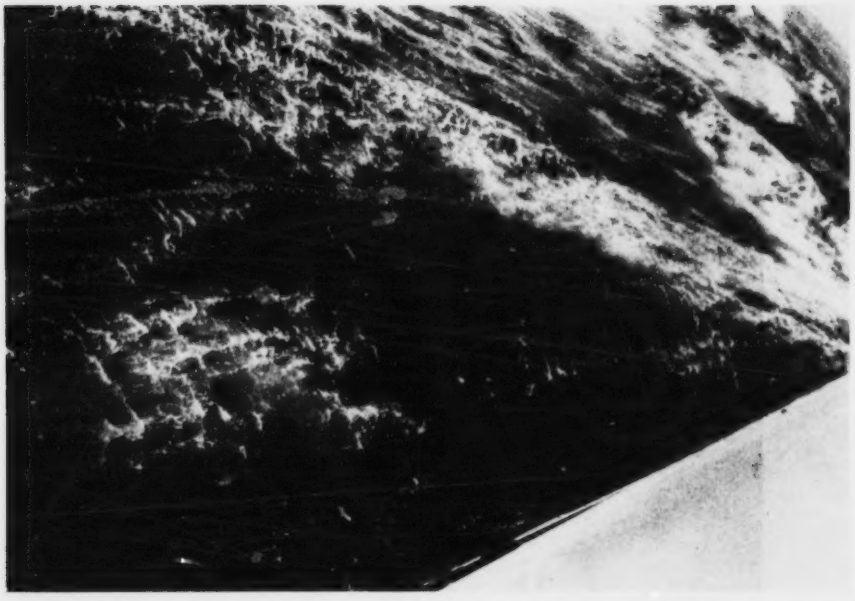
Debris recovered, identified by this marking.

Débris récupérés et identifiés par ces inscriptions.



Recovery of liferaft by CGS "SIR WILLIAM ALEXANDER".

Récupération du radeau de sauvetage sur le NGCC "SIR WILLIAM ALEXANDER".

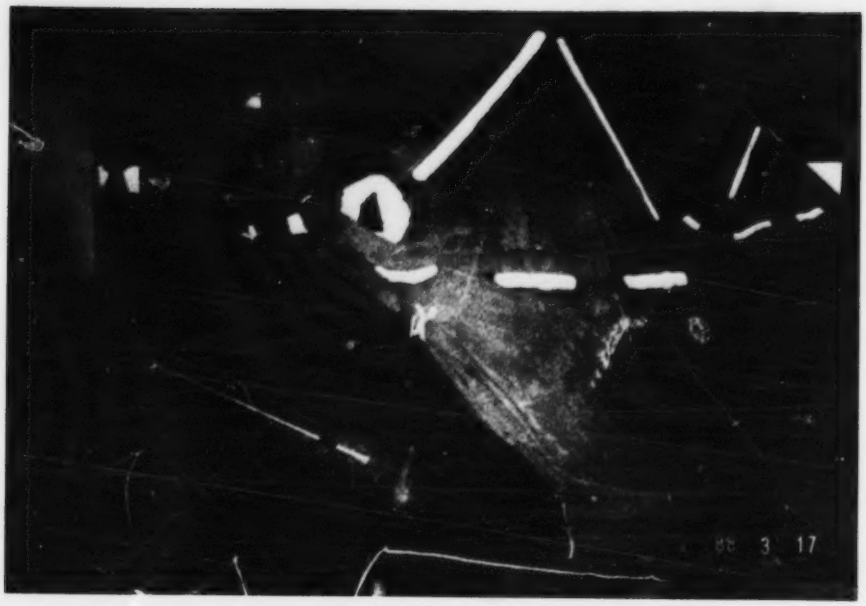


Recovery of liferaft by CGS "SIR WILLIAM ALEXANDER".

Récupération du radeau de sauvetage sur le NGCC "SIR WILLIAM ALEXANDER".

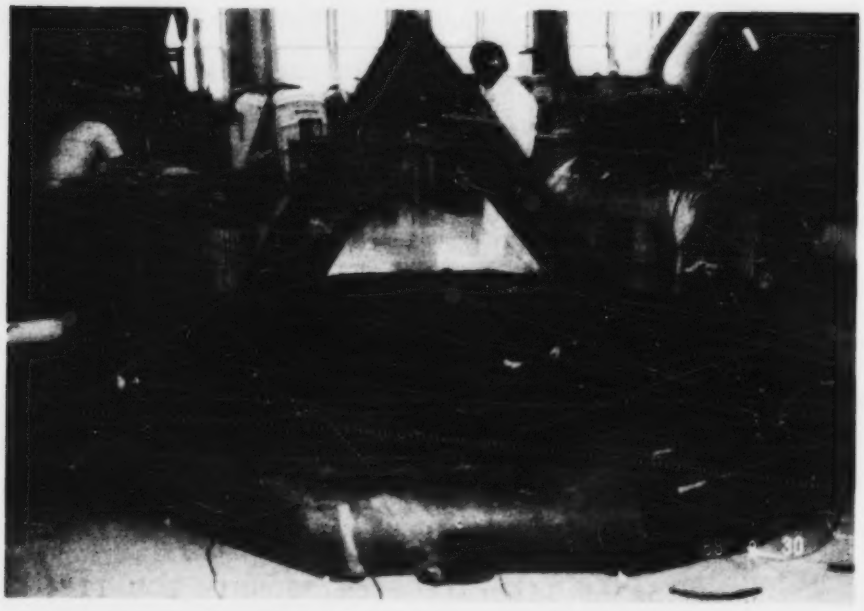
Remains of liferaft from "BONNIE LOU II".

Reste du radeau de sauvetage du "BONNIE LOU II".



Similar liferaft to that aboard "BONNIE LOU II".

Radeau de sauvetage semblable à celui que se trouvait sur le "BONNIE LOU".

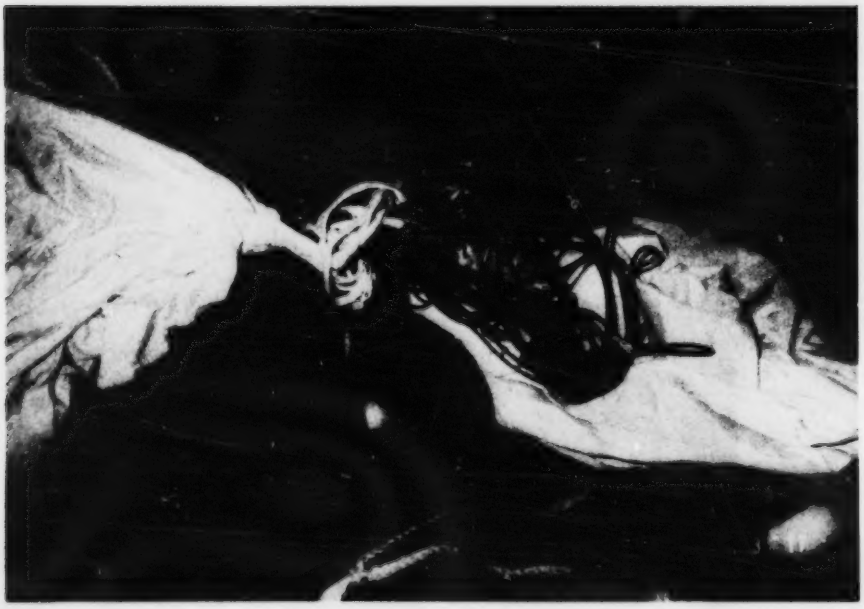


Remains of liferaft from "BONNIE LOU II".

Reste du radeau de sauvetage du "BONNIE LOU II".

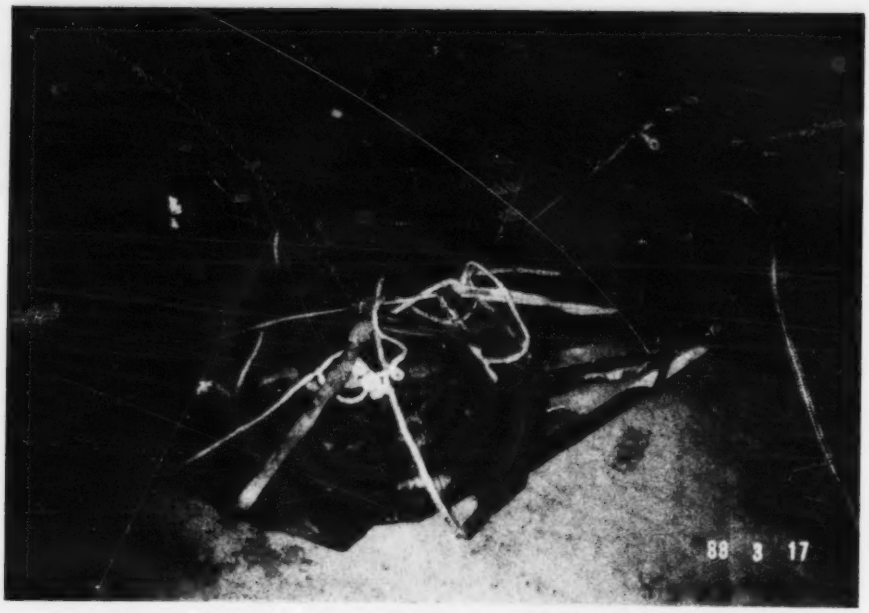
Area of liferaft where seam had separated.

Endroit où le joint s'était décollé.



Rescue quoit line, droques and pump wrapped around arch.

Câble de la bouée flottante, ancre flottante et pompes entourant l'arceau.



Drogue line and boarding ladders wrapped around the lower chamber.

Câble de l'ancre flottante et échelles d'embarquement entournant la chambre à air inférieure.

The separated seam of the lower chamber and the remains of the painter which had been cut.

Joint décollé de la chambre à air inférieure et vestige de la bosse coupée.

ANNEX I

CHAPTER 1486

CANADA SHIPPING ACT

Small Fishing Vessel Inspection Regulations

REGULATIONS RESPECTING THE CONSTRUCTION AND INSPECTION OF FISHING VESSELS NOT EXCEEDING 24.4 m REGISTERED LENGTH THAT DO NOT EXCEED 150 TONS, GROSS TONNAGE

Short Title

1. These Regulations may be cited as the *Small Fishing Vessel Inspection Regulations*.

Construction of Hulls

26. (1) Subject to subsection (2), the sills of doors giving access to the main hull of a fishing vessel shall have a minimum height of 300 mm of which at least 230 mm shall be permanent and the remaining height of sill may be portable, if they are properly stowed in convenient positions.

27. (2) Where a fishing vessel proceeds more than 20 nautical miles from land and there is no method of preventing water from entering the main hull through a broken window or port light, storm shutters and deadlights respectively shall be fitted to those openings unless in the opinion of the inspector the nature of the voyage makes it unnecessary to do so.

(4) All doors giving access to the main hull of a fishing vessel shall be strongly constructed and hung on substantial hinges and locking arrangements shall be such that a door can be opened from either side.

Stability

29. (1) Subject to subsection (8), an inclining experiment shall be conducted in the presence of and to the satisfaction of an inspector in respect of every fishing vessel on completion or near completion of

(*a*) its construction;

(*b*) its registration as a Canadian ship;

(*c*) its conversion to herring or capelin fishing; or

(*d*) its modification as described in paragraph 5(3)(*d*).

.29.1(1)' Subject to subsections (2) to (4), where bulwarks on weather parts of the working deck of a fishing vessel form wells, the minimum freeing port area, expressed in square metres, in respect of each such bulwark shall be not less than

(*a*) 0.7 + 0.035 *l*, where *l* is 20 m or less, and

(*b*) 0.07 *l*, where *l* exceeds 20 m,

where *l*, expressed in metres, is the lesser of the length of bulwark in the well and 70 per cent of the length of the vessel.

(2) Where the height of the bulwark in a well on the working deck is more than 1,200 mm, the minimum freeing port area shall be increased, for each 100 mm in excess of 1,200 mm, by 0.004 m² per metre of length of well.

APPENDICE I

CHAPITRE 1486

LOI SUR LA MARINE MARCHANDE DU CANADA

Règlement sur l'inspection des petits bateaux de pêche

RÈGLEMENT CONCERNANT LA CONSTRUCTION ET L'INSPECTION DES BATEAUX DE PÊCHE D'UNE LONGUEUR RÉGLEMENTAIRE D'AU PLUS 24,4 m ET D'UNE JAUGE BRUTE D'AU PLUS 150 TONNEAUX

Titre abrégé

1. Le présent règlement peut être cité sous le titre: *Règlement sur l'inspection des petits bateaux de pêche.*

Construction de la coque

26. (1) Sous réserve du paragraphe (2), le seuil des portes donnant accès à la coque principale d'un bateau de pêche devra avoir une hauteur minimum de 300 mm et comporter une partie fixe d'au moins 230 mm; l'autre partie pourra être amovible si on a soin de la placer en un lieu convenable lorsqu'on l'enlève.

(2) Si un bateau de pêche s'éloigne de plus de 20 milles marins de la terre et qu'il n'y a aucun moyen d'empêcher l'eau de pénétrer dans la coque principale par une fenêtre ou un hublot venant à se briser, ces ouvertures devront être respectivement munies de contrevents et de tapes, sauf si l'inspecteur estime que la nature du voyage rend inutile cette mesure de précaution.

(4) Toutes les portes donnant accès à la coque principale d'un bateau de pêche seront solidement construites et auront de bonnes charnières, et elles seront munies de dispositifs de verrouillage permettant de les ouvrir de l'intérieur comme de l'extérieur.

Stabilité

29. (1) Sous réserve du paragraphe (8), une fois terminée ou presque terminée

a) sa construction,

b) son immatriculation comme navire canadien,

c) sa transformation pour la pêche au hareng ou au capelan ou

d) sa modification telle que décrite à l'alinéa 5(3)*d*)

tout bateau de pêche doit subir un essai de stabilité effectué en présence et à la satisfaction d'un inspecteur de navires à vapeur.

29.1(1) Sous réserve des paragraphes (2) à (4), lorsque les pavois sur les parties exposées du pont de travail d'un bateau de pêche forment des puits, la section minimale des sabords de dégagement, exprimée en mètres carrés, concernant chaque pavois ne sera pas inférieure à:

a) 0,7 + 0,035 *l*, lorsque *l* est de 20 m ou moins, et

b) 0,07*l*, lorsque *l* dépasse 20 m

lorsque *l*, exprimé en mètres, est moindre que la longueur de pavois dans le puits et 70 pour cent de la longueur du navire.

(2) Lorsque la hauteur du pavois dans un puits sur le pont de travail a plus de 1 200 mm, la section minimale des sabords de dégagement peut être augmentée, pour chaque tranche de 100 m de plus de cette hauteur, de 0,004 m² par mètre de longueur de puits.

(3) Where the height of the bulwark in a well on the working deck is less than 900 mm, the minimum freeing port area may be decreased, for each 100 mm less than 900 mm, by 0.004 m^2 per metre of length of well.

(4) Where the vessel's sheer is such that the minimum freeing port areas, calculated in accordance with subsections (1) to (3), do not provide rapid and effective freeing of water from the deck, those areas shall be increased by such amount as will provide rapid and effective freeing of water from the deck.

(5) The freeing ports of every fishing vessel shall be arranged along the length of bulwarks so as to provide rapid and effective freeing of water from the deck of the vessel, and the lower edges of the freeing ports shall be as close to the deck as possible.

(6) On every fishing vessel, poundboards shall be stowed, and means of stowage of fishing gear shall be arranged, in such a manner that the effectiveness of the freeing ports of the vessel is not impaired.

(7) Every poundboard on a fishing vessel shall be so constructed that it can be secured in position when in use and will not hamper the rapid and effective freeing of water from the deck of the vessel.

(8) Every freeing port over 300 mm in depth of a fishing vessel, shall be fitted with bars spaced not more than 230 mm apart, or with other suitable protective devices.

(3) Lorsque la hauteur du pavois dans un puits sur le pont de travail a moins de 900 m, la section minimale des sabords de dégagement peut être réduite, pour chaque tranche complète ou incomplète de 100 mm de cette hauteur, de 0,004 m^2 par mètre de longueur de puits.

(4) Lorsque la tonture du bateau est telle que les sections minimales de sabords de dégagement, calculées selon les paragraphes (1) à (3), ne permettent pas une évacuation rapide et efficace de l'eau sur le pont, il faudra augmenter ces sections d'une valeur telle qu'elles puissent permettre l'évacuation rapide et efficace de l'eau sur le pont.

(5) Sur tout bateau de pêche, les sabords de dégagement doivent être disposés le long des pavois de façon à permettre une évacuation rapide et efficace de l'eau sur le pont du navire, et les bords inférieurs des sabords de dégagement doivent se trouver aussi près que possible du pont.

(6) Sur tout bateau de pêche, les planches de séparation doivent être saisies, et les dispositifs de saisissage des engins de pêche doivent être arrangés de façon à ne pas nuire à l'efficacité des sabords de dégagement du navire.

(7) Les planches de séparation sur un bateau de pêche doivent être construites de façon à pouvoir être saisies en place lors de leur utilisation et à ne pas empêcher l'écoulement rapide et efficace de l'eau du pont du navire.

(8) Les sabords de dégagement de plus de 300 mm de profondeur sur un bateau de pêche doivent être munis de barres espacées de 230 mm au plus ou de tout autre dispositif de protection approprié.

ANNEX II

APPENDICE II

CANADA SHIPPING ACT

LOI SUR LA MARINE MARCHANDE DU CANADA

CHAPTER S-9

An Act respecting shipping

CHAPITRE S-9

Loi concernant la marine marchande

SHORT TITLE

Short title

1. This Act may be cited as the *Canada Shipping Act*. R.S., c. 29, s. 1.

TITRE ABRÉGÉ

Titre abrégé

1. La présente loi peut être citée sous le titre: *Loi sur la marine marchande du Canada*. S.R., c. 29, art. 1.

Exceptional Vessels and Exemptions from Inspection

Navires d'exception et exemptions d'inspection

Exemption

468. (1) Steamships in excess of fifteen tons gross tonnage, and not in excess of one hundred and fifty tons gross tonnage that are not passenger steamships are exempt from the provisions of this Part relating to annual inspection and instead shall be inspected every fourth year, and such steamships, if fitted with a boiler operating at a pressure in excess of fifteen pounds per square inch, are in addition to such inspection every fourth year subject to inspection of their boilers, life saving equipment and fire extinguishing equipment annually, in like manner and as if they were steamships in excess of one hundred and fifty tons gross tonnage.

Exemption

468. (1) Les navires à vapeur d'une jauge brute de plus de quinze tonneaux mais d'au plus cent cinquante tonneaux, qui ne sont pas des navires à vapeur à passagers, sont exemptés des dispositions de la présente Partie relatives à l'inspection annuelle et doivent, en remplacement, être inspectés tous les quatre ans, et ces navires, s'ils sont munis d'une chaudière soumise à une pression supérieure à quinze livres par pouce carré, sont, en sus de cette inspection quadriennale, assujettis à l'inspection annuelle de leurs chaudières, de leur équipement de sauvetage et de leur matériel d'extinction d'incendie, tout comme s'ils étaient des navires à vapeur d'une jauge brute de plus de cent cinquante tonneaux.

ANNEX III

Search and Rescue Operation

At 0555, March 10, the skipper of the "HALF RASPY" called VCO on 2,182 kHz and, working on 2,582 kHz, expressed his concern over the loss of communication with the "BONNIE LOU II".

The content of this message was relayed to RCC, Halifax at 0606 giving the last known position of the "BONNIE LOU II". Immediate efforts were then made to locate the owner and obtain a complete description of the vessel.

This information was eventually received from the owner's representative in Halifax as the owner was out of the country.

At 0746, CCGS "SIR WILLIAM ALEXANDER" was requested to try to contact the "BONNIE LOU II" using internship frequencies on both VHF and SSB radiotelephones. At this time the "SIR WILLIAM ALEXANDER", together with the supply and anchor handling vessel "SABLE SEA", was involved with the successful rescue of the crew from the Canadian fishing vessel, "ADVENTURE" which subsequently sank.

At 0954, RCC issued a PAN message which was to be broadcast at frequent intervals on both R/T and C/W.

No response was heard following the R/T search by the "SIR WILLIAM ALEXANDER" nor from a similar R/T search carried out later by CCGS "WILLIAM".

At 0925, CF Buffalo aircraft, R-459 from 413 Squadron, Summerside, Prince Edward Island was tasked followed, during the day, by CF Aurora aircraft R-104, 107 and 108 from Greenwood Air Base, Nova Scotia, a second Buffalo from Summerside and a USCG Hercules R-1504 from Gander, Newfoundland.

Surface vessels tasked March 10 included CCGS "SIR WILLIAM ALEXANDER", "WILLIAM" and "NARWHAL" and DFO vessel "TEM". Additional aircraft joined the search 1200, March 11: Aurora R-105 from Greenwood, and USCG Hercules R-1719 from Gander.

At 1401, March 10, debris was sighted from the air in position 43°05'N, 58°20'W, 61 miles south of the LKP of the "BONNIE LOU II". Following a thorough search of that particular area, R-104 departed for base at 2011 after releasing a Type 525, channel 17 sonar buoy. This buoy was never sighted again.

Throughout the afternoon, the surface vessels were reporting adverse weather conditions with the "WILLIAM", 72 miles north-west of the reported position of debris, in dense fog at 1400, but proceeding with the intent to retrieve the sighted debris. The "TEM" was also directed to the same area to be available to continue the search for the "BONNIE LOU II" at first light, March 11.

At 1958, March 10, the master of the "SIR WILLIAM ALEXANDER" was appointed on-scene commander (OSC) upon the departure of the last aircraft.

The "WILLIAM" arrived at the search area at 2200, March 10, but strong winds, rough seas and reduced visibility in darkness negated any attempt to locate or search, and a decision was made to await daybreak before resuming the search.

In the meantime, RCC was compiling drift plots for both the missing vessel and the liferaft from the vessel. From these plots, quadrantal co-ordinates were determined for an area within which possible positions for both craft would be indicated after allowing for drift.

At 1035, March 11, a low-confidence aerial sighting of an inverted green hull was made in position 42°43'N, 58°03'W but after several further sweeps, the hull could not be seen.

More definite debris was sighted at 1155 in position 42°53.4'N, 58°10.6'W but when the "WILLIAM" arrived in the area, the debris could not be located. The surface weather conditions in this location were south-westerly winds of 40 knots with a heavy sea and swell and good visibility.

At 1421, the "WILLIAM" sighted more debris in position 42°58.8'N, 58°10'W but could not recover due to high seas and 50 knot winds.

It is significant to note that this same debris was sighted by an aircraft one hour 39 minutes later 6.1 miles to the south indicating a drift of 3.7 knots.

At 0800, March 12, the captain of Aurora R-108 was designated as OSC and the "SIR WILLIAM ALEXANDER" as co-ordinator, surface search (CSS).

At 1232, the "WILLIAM" reported sighting an orange type float, which appeared to be weighted, in position 42°48'N, 57°27'W.

At 1305, the "SIR WILLIAM ALEXANDER" recovered a liferaft in position 42°46.2'N, 57°25.1'W. The raft was without its canopy and the seam in the lower chamber had separated for a length of approximately 2.5 metres. Recovered with the

liferaft was a discharged inflation cylinder bearing the number 26470. This number was subsequently confirmed to be that on such a cylinder carried aboard the "BONNIE LOU II". The retrieval of the raft was carried out in severe weather conditions with westerly winds of 45 knots and rough seas.

At 1714, March 12, the search for the "BONNIE LOU II" was scaled down by standing down all air resources and by the release of the "WILLIAM" and "TEM". Meanwhile, the "SIR WILLIAM ALEXANDER" and "NARWHAL" resumed the search in the 'debris area' at 0600, March 13 with the winds from the west-north-west at 25-30 knots and moderate seas.

Various small pieces of debris were located and recovered by the "NARWHAL" including one highflyer and one piece of plywood with the following marks made by black marker pen:

Trepassey

Stickman
Figure

This piece was later identified as being part of the starboard bulkhead of the wheel-house/dog-house of the "BONNIE LOU II".

All sightings and recovery of debris were made within a radius of 22.5 miles and at distances of between 61 and 94 miles from the LKP of the "BONNIE LOU II".

The entire search was suspended at 1843, March 13, 1988 and the urgency broadcast was down-graded to a safety message at 1941, March 13.

The search and rescue operation primarily involved four surface vessels and eight aircraft, whilst fishing vessels and other surface craft traversing the area were alerted by the broadcast urgency calls.

During the search period, a total of 156.2 vessel hours was utilized in the coverage of approximately 12,166 square nautical miles as follows:

	Transit	Search	Total	Area
Aircraft				
413 Squadron R 459	5.10	4.50	9.60	
R 455	13.20	13.30	26.50	
404 Squadron Aurora 0107	1.30	4.00	5.30	
415 Squadron Aurora 0108	5.80	15.30	21.10	
405 Squadron Aurora 0105	2.30	3.40	5.70	
Aurora 0104	1.60	4.50	6.10	
USCG Hercules 1504	3.00	5.60	8.60	
Hercules 1719	2.50	5.30	7.80	
	34.80	55.90	90.70	9,000 sq.n.m.
Surface vessels				
CCGS "SIR WILLIAM ALEXANDER"	30.20	36.05	66.25	1,172 sq.n.m.
"WILLIAM"	40.90	20.00	60.90	756 sq.n.m.
"NARWHAL"	42.33	24.17	66.50	708 sq.n.m.
Dept. of Fisheries and Oceans "TEM"	22.42	20.08	42.50	530 sq.n.m.
	135.85	100.30	236.15	3,166 sq.n.m.
Totals	170.65	156.20	326.85	12,166 sq.n.m.

ANNEX IV

Stability Review

Because of the lack of basic hull and loading data, the precise stability characteristics of the "BONNIE LOU II" at the time of her loss are unknown, and can only be estimated. It should be noted that the vessel had operated safely without any reported stability related mishap for approximately 24 years, and therefore it is likely that a major factor in her loss was the severity of the prevailing weather.

A loading condition survey and rolling period test were carried out on the "SCOTT G", May 19, 1988 to provide data from which estimated initial transverse stability characteristics of the "BONNIE LOU II" could be derived. In this regard, it should be noted that a rolling period test is often employed as a reasonably accurate method for quickly approximating a vessel's transverse metacentric height (GMt) - particularly when it is impracticable to carry out the more definitive inclining experiment, and its accuracy is based upon the relationship between the GMt and the observed rolling period (Tr), in terms of the breadth of the vessel.

The test was performed with the "SCOTT G" floating upright and clear of the wharf, and rhythmic rolling was induced by hauling on a rope attached to the masthead. Upon sufficient momentum being attained, hauling was stopped and the time taken for five successive and completely free roils was recorded by stopwatch. This procedure was repeated three times, the vessel having been allowed to come to rest between each successive set of five rolls. The average value from the total of fifteen complete rolls was found to be 4.054 seconds which, in conjunction with the existing loading characteristics and waterline beam, indicated that the vessel had a GMt of approximately 1.0 metre. This GMt is typical of similar small fishing vessels and is indicative of adequate initial transverse stability characteristics.

The approximate deadweight and trim of the "SCOTT G" at the time of the rolling period test were generally as shown in Fig No. 1, and reportedly the basic structural arrangement and layout of fishing gear etc., was virtually the same as the "BONNIE LOU II". The outline general arrangement shows a typical long-lining fishing vessel of closed construction, however, the incorporation of a watertight welldeck approximately 0.56 m below maindeck level, some 2.1 m long, and extending the full breadth of the vessel in way of the engine-compartment, is an unusual and significant feature. Welldeck drainage was provided by a total of four 50 mm diameter scuppers, one of which was located at each of the lower outboard corners of the well. The scupper pipes were horizontal, passing directly through the shipside planking

approximately 0.53 m below the main-deck gunwale, and no closing plugs or hinged flaps were fitted.

By 1800, March 8, the "BONNIE LOU II", having fished previously at 'Seventy Seven Peak Gully', had been at sea approximately 60 hours and, because of the weight of the remaining unconsumed oil fuel, fresh water, ice, bait and catch etc., it is likely that her mean draught was then at least 150 mm greater than that shown in Fig. No. 1, and it is estimated that her GMt had decreased slightly from that of the calculated in-port 'spent' condition, to approximately 0.96 m. In other words, she still retained high initial stability.

In view of the radio messages received prior to her loss describing some structural damage and flooding, the post-casualty stability analysis focused upon the detrimental effects of the heavy seas which were reportedly shipped and retained on deck, together with the likelihood of subsequent downflooding and foundering. A possible sequence of events leading to the loss of the vessel in the storm conditions is examined in the following paragraphs.

It is apparent from the outline general arrangement that any heavy seas shipped from starboard, having entered the closed slaughter-house by way of stove-in bulkhead sliding doors or, more particularly through open or unsecured ship side fishing doors, would be retained in that structure and accumulate in the welldeck. The area of the deck shelter and volume of the welldeck are such that a 'nominal' layer of shipped water only 150 mm above maindeck level would weigh some 10.3 tonnes. The weight of this shipped water would lower the vessel's freeboard some 140 mm, and also reduce the GMt to approximately 0.82 metres.

The concurrent free-surface effect of the shipped water would also cause a drastic deterioration of the transverse stability, and it is calculated that the GMf, which is indicative of a vessel's initial stability, would have been reduced to only 82 mm.

The transverse stability of the "BONNIE LOU II" would have remained impaired for as long as the shipped water remained on board, and it is calculated that the four 50 mm diameter scuppers would required at least six and one half minutes to clear the well, provided they were free of any debris or obstruction, and remained above sea level. Reportedly, it was normal practice to stow and secure tubs of long-line on the port side of the vessel and also in the welldeck, while sailing between fishing grounds. In this event, it is considered likely that the obstruction so caused, would have impeded the flow of water to the port side scuppers of the heeled vessel and significantly increased the time required to clear the welldeck of water.

It should be noted that the above estimated initial stability characteristics and shipped water discharge rates are based upon the 'ideal' static sea state and clear and unimpeded openings. In actual dynamic sea conditions, the reserve transverse stability of small vessels and also freeing-port of scupper efficiencies, are subject to considerable fluctuation.

While the seas reportedly shipped and retained on deck are considered to have been the major factor in the loss of the vessel, it is also possible that her stability, freeboard and reserve buoyancy were reduced by an unnoticed accumulation of bilge water resulting from the working of the hull and deck, which could have been brought about by the stress of such severe weather acting on the 24 year old wooden vessel.

It would appear that while the "BONNIE LOU II" was in the highly vulnerable condition indicated, the dynamic heeling effects produced by the weight and impetus of additional heavy seas shipped from starboard, further lowered and overcame her initial ability to recover. When heeled toward the limiting range of positive stability, the vessel, because of the reduced righting moment and gravitation of shipped water to port, remained heeled over with the welldeck scupper immersed. The reduced efficiency of the scuppers increased the time required to clear the shipped water off the deck, retarded the vessel's recovery and caused the coaming of the port side wheel-house door to remain submerged. The water shipped in the wheel-house subsequently downflooded into the engine-compartment and forward accommodation space by way of the low 65 mm sill of the engine-compartment hatch on the port side of the maindeck and through the open accommodation access, preventing the vessel's recovery, and continued downflooding until all reserve buoyancy was lost and the vessel foundered.

ANNEX V

Description of the equipment found with the liferaft:

- one CO_2 cylinder with operating head cover, operating head, 100 mm of conduit for firing cable and one high pressure hose;
- two high pressure hoses with Y connection attached to the liferaft;
- one CO_2 cylinder pocket;
- four water pockets;
- one righting strap;
- one sea cell pocket;
- external and internal grab lines;
- two sea cells with 3 m of wire;
- one exterior locator light;
- two plugs for safety relief and topping-up valves;
- two safety relief and topping-up valves;
- one restraining strap for Class A survival pack;
- two boarding ladder assemblies;
- two sea drogues;
- one Dunlop Bee Hive pump;
- one floating knife;
- one rescue line minus its quoit;
- one floating knife patch;
- one painter patch;
- one topping up valve in arch tube;
- one topping up valve in floor; and
- 1.2 m of painter line.

The following equipment was missing from the liferaft:

- 24 m of painter line, where cut;

- one firing cable;
- one plug for arch tube topping up valve;
- one plug for floor topping up valve;
- one deflating plug for upper buoyancy chamber;
- one interior comfort light;
- complete inner canopy;
- complete outer canopy excepting four canopy anchor patches and small amounts of canopy material and bungee cord attached;
- one Class A survival pack;
- one set of paddles;
- two sponges;
- one rescue line quoit; and
- two instructional manuals (English and French).

The general condition of the inflation equipment salvaged was found to be good.

The CO_2 cylinder was empty of gas, the operating head, high pressure hoses, CO_2 inflation valves, safety relief and topping up (SRTU) valves, arch tube and floor topping up valves were all tested and found to be functioning normally.

There was no evidence of fabric deterioration or of abrasions on the outer and inner floors, nor on the upper or lower buoyancy chambers. However the separation of upper and lower chambers occurred between and SRTU valve around the port side, past the high pressure hose and ending at the beginning of the boarding ladder in the bow section.

The lower chamber main seam separated in three places. One separation is 30 cm long; damage occurred directly in front of the high pressure valve. There were no frayed edges on the seam. A 53 cm section of seam going towards stern was intact. Frost barriers are fitted to the inside of this section.

The second separation involved two panels. The main seam separation measured 150 cm in length. The outer edge of the top portion of the main seam is jagged and frayed. The separation occurred at the painter patch panel. A 5 cm section where the four chamber seams meet is intact;

The third separation measured 71 cm in length. The upper part of the seam is jagged and frayed. A tapered section of this seam 46 x 2.5 x 0 cm was torn from the upper portion of the seam. This portion remained stuck to the upper buoyancy chamber 7 cm from the end of the seam separation, and at a 90 degree angle with this seam there is a 4 cm rip. This rip appears to have been made after the seam separated because there is no rip in the tapered section which was a part of the torn seam.

There was no visible evidence that the raft had been patched or that repairs had been carried out on the seams. This observation was confirmed by laboratory analysis.

The upper buoyancy chamber had two small punctures in line with each other on the port bow section one panel forward of the arch tube. The punctures were 7 cm about. The chamber was completely dry inside. There was one cut on the stern section reported to have been made by a pocket knife after the raft had been recovered.

The arch tube had one small hole 6 mm in diameter near to the position of the internal light. A small amount of water was found inside the tube.

The only remaining parts of the outer and inner canopies were four canopy anchor patches, two of which contained small fragments of the outer canopy plus 76 cm of bungee cord. A small piece of outer canopy 5 x 61 cm remained stuck to the buoyancy chamber. There was canopy adhesive around the buoyancy tube, on a 10 cm area around the arch tube deflation plug, and on the very top o the arch tube.

The sea cells (sea water batteries) had activated. The wire connecting them to the dual light connection was broken at the connection. The interior light was torn from its patch.

Two sea anchors, one rescue line, one bee-hive pump and one floating knife were found tangled in a mass around the pump hose. One sea anchor was properly attached to the painter patch. The spare sea anchor was unattached. The rescue line was unattached and its quoit was missing. The knife retaining cord was pulled from the knife handle and torn away from the elastic strap on the knife patch, the strap was broken.

The painter was secured to the painter patch and had been cut 1.2 m from the patch.

The survival pack retaining strap was tangled around the high pressure hose. No securing knot was found in the strap.

ANNEX VI

Winds Speed Recorded at Sable Island

March 7, 1988	1200	south-west	14 knots
	1300	south-south-west	11 knots
	1400	south-south-west	10 knots
	1500	south-south-west	9 knots
	1600	south-west	8 knots
	1700	south	5 knots
	1800	south-south-west	6 knots
	1900	south	9 knots
	2000	south	7 knots
	2100	south-west	9 knots
	2200	south-west	5 knots
	2300	south	11 knots
	2400	south-south-west	10 knots
March 8, 1988	0100	south	12 knots
	0200	west	11 knots
	0300	north-west	8 knots
	0400	west-north-west	11 knots
	0500	west-north-west	13 knots
	0600	north-west	16 knots
	0700	north-west	22 gusting 27 knots
	0800	north-west	25 gusting 31 knots
	0900	north-north-west	28 gusting 36 knots
	1000	north-north-west	30 gusting 38 knots
	1100	north-north-west	28 gusting 39 knots
	1200	north-north-west	28 gusting 41 knots
	1300	north-north-west	32 gusting 44 knots
	1400	north-west	27 gusting 48 knots
	1500	north-west	38 gusting 51 knots
	1600	north-north-west	42 gusting 56 knots
	1700	north-west	43 gusting 53 knots
	1800	north-north-west	40 gusting 54 knots
	1900	north-north-west	43 gusting 55 knots
	2000	north-north-west	42 gusting 55 knots
	2100	north-north-west	42 gusting 55 knots
	2200	north-north-west	42 gusting 60 knots
	2300	north-north-west	42 gusting 56 knots
	2400	north-north-west	40 gusting 57 knots
March 9, 1988	0100	north-north-west	40 gusting 54 knots
	0200	north-north-west	42 gusting 54 knots
	0300	north-west	38 gusting 55 knots
	0400	north-north-west	39 gusting 50 knots
	0500	north-north-west	37 gusting 53 knots
	0600	north-north-west	38 gusting 49 knots
	0700	north-north-west	35 gusting 50 knots
	0800	north-north-west	37 gusting 50 knots
	0900	north-north-west	34 gusting 45 knots
	1000	north-north-west	31 gusting 43 knots
	1100	north-north-west	31 gusting 38 knots
	1200	north-west	29 gusting 41 knots
	1300	north-north-west	26 gusting 33 knots